COMPLETE GUIDE TO HANDLOADING

A Treatise on Handloading for Pleasure, Economy and Utility

By

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HARRY M. POPE CHATS WITH THE AUTHOR AT CAMP PERRY. THAT HAT IS FORTY YEARS OLD AND HAS ALWAYS BEEN WORN BY POPE WHILE SHOOTING A MATCH. IT IS HIS "GOOD LUCK" EMBLEM

DEDICATED TO

HARRY M. POPE

(*The Old Master*)

It is doubtful if any one individual has done as much for the shooting game as Harry M. Pope, that barrel maker and match shooter who for more than sixty years has been an active member of the shooting fraternity. Failing eyesight and the encroachments of Time have not dulled his keen understanding of shooting problems—or his skill at his favorite old lathe. The expert handloader knows that experimental firing will locate one load which shoots better in his gun than any other. H. M. Pope learned that before most of us were born. At the turn of the century when Pope was most active as a commercial barrel maker, he developed the most accurate load for each barrel. He knew what variations in cases, in bullets, in primers and in powder could do to accuracy. So he found the best combination—and the new data went with each barrel. And so to that Little Old Man in New Jersey, with recollections of many happy evenings listening to his yarns of yesteryear, this volume is respectfully dedicated. There will be but ONE H. M. Pope.

THE AUTHOR

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PART ONE

INTRODUCTION

THE big sedan slid close to the curbstone, decelerating rapidly. The driver reached for the instrument panel, snapped off the ignition, the lights, and tightened up on the emergency brake. Nonchalantly he slid across the seat, opened the door, alighted and looked up at the big house sandwiched between others in the closely packed city street. A small attic window set close to the peak of the roof glowed faintly from an internal light. Something doing up there! . . . Hastily he climbed the porch stairs and let himself in with his pass key. He breezed through the house with a cheery greeting and his unasked question was immediately answered.

"Sure, he's up in the attic monkeying around as usual. Don't you gun bugs ever get tired?"

A moment later he was in the attic . . . and sure enough, "doin's" were afoot. Obie was handloading. Before him on the long sturdy bench constructed by himself with its purpose in view at the time of design was a long row of assorted loading tools—FA, Pacific, and others. A small gasoline stove was roaring merrily in one corner of the neat little workshop. On it a pot of bullet metal was acquiring that "liquid" appearance.

What was it all about?

A couple of gun bugs again at the sport of constructing a batch of special handloaded ammunition.

For twenty years the writer has been playing with this subject. His initial work was accomplished with the crudest of tools and a minimum of intelligence. As he looks back on the early days he sighs with relief—relief to think that he actually lived through some of the concoctions put together.

As we look back through the years we seem to recall that initial handloading—or reloading, as you may choose to call it—which began with an old .38 Long Colt and a non-adjustable Ideal tool having a bullet mould built into the end. A lot of fun we had. Since that time countless thousands of rounds of ammunition have been handloaded in calibers too numerous to mention. At no time have we ever been really "tired" of handloading. Perhaps that day will sometime arrive. When any factory can load any cartridge that will shoot quarter-inch groups at 100 yards, and when we can duplicate and improve upon said grouping, then we will retire, for the end will be in sight. Even then, we may strive for those quarter-inch groups at 200 and possibly 300 yards . . . but that is just a dream.

Every modern development in the shape of arms and ammunition is today directly traceable to the efforts of handloaders—experimenters, if you please. All credit is due these pioneers in every industry.

I sat in the office of an executive of a large arms plant not so long ago. The executive began an attack upon handloading. Naturally I countered.

"Our business," he insisted, "is the manufacture and sale of arms and ammunition. Our profit on components is woefully small, of course, and naturally we do not like to encourage any home ammunition manufacture."

I knew this executive well, and, knowing that he did not mean all he said, I shot a direct question at him. His reply was enlightening.

"Yes," he acknowledged, "you handloading chaps are probably responsible for most of our development work today. You find more fault than the hunter, but the most practical feature is that you bring your complaints direct to the manufacturers, whereas the average hunter is inclined to neglect this and broadcast his criticisms to the world at large.

"Practically every development of any importance can be directly traced to you chaps; it was first worked out and proved by the handloading fraternity, and we later adopted it."

This is quite true. The so-called "wadcutter" target cartridge was the product of handloaders. It was first worked out by A. L. A. Himmelwright back in 1900. This same bullet has been made available to reloaders since that time by the makers of Ideal bullet moulds.

The original wadcutter was built for the .44 Smith and Wesson Russian—a 175-grain bullet bearing the Ideal number 429220.

Shortly after this came another group of wadcutter bullets, starting with J. B. Crabtree's Ideal #360345 in 1903, B. F. Wilder's #360271 in 1904, and Himmelwright's #360302 in 1905. Around 1910 Winchester and Remington began the factory production of wadcutter target loads in the .38 Special followed by other calibers—merely because

the reloaders had created a demand for this type of ammunition.

Most of the truly modern cartridges were also developed in their initial stages by the handloading fraternity. . . . Today handloading is gaining in popularity. More handloaded ammunition was put together during 1936 than in any previous year since the 1912 era.

Why do we chaps handload our ammunition?

The writer asked that question of a half-dozen handloaders. Here are some of the replies:

"It saves me a lot of money."

"I can develop numerous loads not available on the market."

"I get a lot of fun out of it."

"There is more fun in shooting your own product."

"I like to use my big-bore handguns indoors and my high-power rifles at short ranges."

"I don't like the noise, the recoil and the surplus power of standard factory ammunition."

The cost of handloaded ammunition is ordinarily much less than that turned out by the factory, yet the true gun bug and experimenter is constantly spending much more for handloaded ammunition, for components and for loading tools, than he would ever spend on his hobby if only factory ammunition were available. The chap who handloads is a source of great profit—not loss—to the maker of arms and ammunition. He rarely limits himself to one cartridge or one caliber. He is always trying something new. He is never satisfied.

And thus does the world progress.

PART ONE

I

PROBLEMS OF THE HANDLOADER

THIRTY or forty years ago the average gun bug—if he didn't feel humiliated to have that "insulting" title wished on him—found it necessary to load his own ammunition if he really wanted to get anywhere in the gun bug clan. In those days excellent results were obtained through painstaking labor—not necessarily precision equipment. The reloading of ammunition was a ceremony, one which required a certain ritual to perform, and the man who strayed from the accepted ritual was either outlawed by his associates or suffered from the pangs of a guilty conscience for many moons to come.

Today we have no such ritual. Reloading is performed with considerably less care—except by a few fine technicians and target shots—and the results are often correspondingly poor. All this despite the fact that handloading has progressed to a remarkable extent; tools which would have been the envy of the 1900 loader are now available, and powders which excel in ease of handloading, cleanliness, and performance, anything which was available in that particular day.

The reloader of yesterday cared little about velocities and pressures. He confined his activities solely to the development of accuracy and power. Today many reloaders worry along in much too haphazard a fashion. They do not prepare their concoctions with a professional eye or with attention to detail. They do not carefully consider the problems of safety. The net result is that all arms manufacturers have withdrawn the handing out of loading data and have cancelled their guaranties on arms as well as on components. Before me is a small box which contained standard factory bullets. On the bottom is the following enlightening label:

"**Special Notice.** The ammunition components contained in this package are of the same quality as those used in the manufacture of our loaded cartridges. Having no control over the loading, however, we do not guarantee the same results when components are sold separately as with Kleanbore loaded cartridges. (Signed) Remington Arms Co., Inc.

A similar label appears on a box of .30/06 primed shells. It reads:

"**Not Guaranteed.** The ammunition components contained in this package are of the same quality as those used in the manufacture of our loaded cartridges. However, having no control over the loading, we do not guarantee these goods when sold separately. (Signed) Remington Arms Co., Inc."

And so it goes.

Not long ago my particular revolver club shot a match with another team in a distant city. I was paired up with a stranger. At the moment I was using my .38 Special with a handload approximating the standard factory Mid-Range. My competitor was using an old .45 Single Action of early extraction which had been fitted up with some extremely excellent sights. Despite the 7½-inch barrel, however, there was a tremendous roar and concussion every time the hammer "faw down an' go boom." After the second shot I casually asked the stranger what sort of dynamite he was using.

His reply did nothing to improve my peace of mind, and incidentally caused me to turn out the lowest score I ever shot in a match.

"Oh, it's a full charge load," he replied casually "I cast my own bullets and load 'em up. Sure, it's a heavy load. I like heavy loads! I can shoot 'em better."

For some peculiar reason I commenced to get the jitters. "What do you mean 'heavy load'?" I queried faintly.

The reply was quite casual but far from soothing. "Oh, standard lead bullet about 250 grains and about 10 grains of #5."

It so happens that the standard factory .45 Colt cartridge develops a velocity of about 860 f.s. with a 255 grain bullet. A charge of 7.3 grains of Pistol 5 duplicates the standard factory load; 8.5 grains is listed as a *maximum* charge developing 925 f.s., and yet this chap was blithely using a poison load which must have more than doubled the standard factory pressure. The maximum load, by the way, is designed only for heavy Colt New Service Model revolvers, not the Single Action type of construction. The mere fact that this particular gentleman had been using the load over a long period of time without blowing himself to Kingdom Come didn't alter the situation to any great

extent. I felt decidedly nervous and ill at ease.

One cannot take too much care with handloaded ammunition. In the old days of black powder loadings, an overcharge usually merely kicked out of the muzzle a lot of unburned powder. True, it was unpleasant to the shooter, but it could not well be classed as dangerous. Smokeless powders, however, do not work in that manner. It is surprising what a great amount of abuse the modern rifle, revolver or other weapon will actually stand, but there is a limit, and sooner or later the careless loader creates serious damage with a blown-up gun. Incidentally, these blown-up guns more often hurt some innocent bystander than the careless shooter, if that is any satisfaction to you. They can, however, injure both parties at the same time, and if you don't care about the other fellow it is worth while bearing that interesting fact in mind.

Black powder is now more or less a thing of the past. It is no longer being used by the serious target shooter except in experimenting with old-time weapons in a more or less casual manner. No effort will be made in this volume to bore the reader with a lot of useless discussion of the obsolete, either in powders or in old-time loading tools no longer available upon the open market. Black powder can be obtained, however, if you really feel the necessity for it. It is extremely destructive to brass cases: these cases must be washed immediately in warm soapy water to prevent corrosion, and carefully dried, while the gun which shot them has to be given an excellent dose of hot water and elbow grease to remove the messy fouling. Why bother with it?

The handloader can now purchase bench-type loading tools, tong types in various forms, assorted "straight-line" equipment, and automatic loading machines which turn out complete ammunition with a single stroke of the lever. You can load fast or slow, as the spirit moves. You can invest several hundred dollars in complete loading equipment or a mere ten-spot will start you on the road to much happiness.

There is one rule which must not be overlooked. You get only as much out of your ammunition as you put into it, whether it be pleasure or labor. You can assemble all types of loads, either cheap or expensive, with the best of them costing less than half the price of a factory load.

There are three distinct types of handloading. I would classify these as "speed," "precision," and "experimental."

Speed handloading should never be attempted with ordinary equipment. The procedure is highly unsatisfactory in performance, and if a full charge is attempted there is always a possibility of an overload closely approaching the danger point. Speed loading also requires specialized equipment and is intended primarily for clubs or individuals who desire to prepare large batches of a single cartridge.

Precision ammunition is the reproduction of a proved and tested load wherein the experimenter desires to duplicate a product of match accuracy.

Experimental loading is another proposition altogether. This is essentially the development of new and special loadings. It does not necessarily refer to "maximum" loads but is an attempt to develop a particular combination of cartridge case, primer, powder, powder weight and bullet which will reach a predetermined objective from the standpoint of accuracy, bullet expansion or some other performance. Experimental loading requires extreme attention to detail. An effort must always be made to eliminate any variables, whatever they may be, which might give an "unaccountable" result in the actual test firing. Here a precision balance must be used and the operator must train himself in using it to full advantage.

In years of reloading and discussing the subject with countless gun bugs and experimenters of both high and low station, I have seen some remarkable precision loads turned out with the crudest of tools. By the same token I have seen some of the crudest possible concoctions turned out by chaps with the best of modern equipment, complete to the last straw. I have seen handloads in the .30/06 turned out with crude tong tools, badly worn and sloppy in operation, which would do 1¼-inch groups at 100 yards. I have seen similar loads turned out with equipment which reloaders would be proud to possess, yet which could not be made to stay inside a four-inch circle at the same range.

While it seems like unnecessary repetition I should like to impress upon every beginner the extreme importance of the human element in handloading. The experienced man has found out long ago that the ultimate test of handloaded ammunition is in the shooting, and that he cannot expect poorly assembled cartridges to deliver the best performance. Experience is, after all, the best teacher; and yet—*we can learn much from the experiences of others!*

The beginner in the reloading game will do well to choose his equipment carefully, purchasing the lower priced pieces as he needs them. Later, as he gets into the game, he can invest in the more expensive and better types. The idea is much the same as in shooting—one doesn't begin with the heavy, high-priced gun. I have found that the

man who reloads is constantly adding to his loading-tool equipment. He increases the size of his armory, and the acquisition of any new gun brings about the desire to develop for it some form of handloads. He often purchases factory cartridges, shooting them up solely to get the cases. He buys countless factory components. He studies available loading data; and then he experiments.

point bullet in the .30/06 loaded to a velocity of around 1600 f.s. That particular load happened to knock 'em cold. It was superbly accurate and exceptionally economical. I missed a great many shots—but that was *my* fault. A few groups at a target clearly showed that at 100 yards that load was capable of hitting any chuck—if I did my part. . . .

A battery of guns such as the above calls for handloading. In the group one finds Springfields, Hornets, Swifts, 7-mm., .257 Roberts, and several others

The writer has loaded and fired countless handgun and rifle cartridges of absolutely minimum power. He has developed loads for the Springfield, 7 mm., and others which were highly satisfactory from the standpoint of both power and noise, and had sufficient accuracy to permit their use on a 50-foot indoor range. In this he has used existing components, various cast bullets and assorted "buck shot" of suitable size to properly fill the bore. Were it necessary to confine himself exclusively to factory ammunition it is doubtful if he would feel inclined—or financially able—to shoot one-tenth of his present annual quota of ammunition. Fifteen years or more ago—before the advent of the Hornet and Swift—my favorite chuck load was the .32/20 Winchester-make soft-

Forty years ago our makers of firearms advocated reloading. So did the builders of ammunition. Boxes of cartridges gave instructions for the care and reloading of empty shells, clearly specifying the size and type of primers to use. We were a nation of riflemen, not a nation of dubs. Why then can't we do today what we did yesterday? The *careless* reloader cannot duplicate the high standard of quality found in factory ammunition. On the other hand, the *careful* reloader can improve on nearly any factory product, particularly in so far as performance in *his particular gun* is concerned

No two rifles of any given make and model can be depended upon to shoot side by side with equal accuracy when using all makes of ammunition

Why? Should you ask that question of five ballistic engineers, the chances are that you would get five different answers; and yet the problem is quite simple. The answer is merely that each rifle, because of individual characteristics beyond the control of the manufacturer, is more partial to one particular load than to another. We may load a standard charge and get accuracy equal to that with factory fodder. We may increase that charge by one-tenth grain and find that our rifle has become erratic; or, on the other hand, we may find that its accuracy has improved greatly.

Handloading is truly a science, not a hit-or-miss proposition. I distinctly recall the load with one of my pet Springfields which wouldn't do better than two-inch groups at 50 yards. In another of my barrels it went well under one inch. I was using a gas check bullet of about 180 grains weight at a velocity in the vicinity of 2000—not a heavy load. I increased the charge three-tenths of a grain to experiment, and my group size was cut in half.

I went to the other extreme and reduced the powder charge with identically the same effect on group size. I then reloaded another batch of the first group specifications and duplicated the inaccurate performance. The slightly higher and lower powder charges were again shot with group size averaging less than half. Apparently that particular load at that particular velocity stirred up some peculiar form of vibration in my barrel and thus whipped it all over the target. Thus the importance of endeavoring to record not only your loading data *but its performance.*

The man who wants performance goes after it in a practical, scientific way. He never relies on memory, he never resorts to guesses. He records all data on his loadings and is able to duplicate performance at any time. Even when he experiments with "unknown" loads he does NOT guess. Instead, he uses his good judgment, estimating results from past experience with the concoction of loads of known specifications.

Here and now I wish to caution every reloader against the use of so-called "maximum" loads. This warning will be repeated many times throughout these notes. The warning should be heeded!

The man who reloads has opened for himself a great field for clean, honest sport. He invests money in equipment often equivalent to the price of a new high-power rifle. The important thing is that he enjoys the use of that reloading equipment fully as much as he enjoys the use of his rifle. The first thing you should do in preparing to reload is to plan out systematically just what cartridges you desire to work with, the amount of money you wish to spend, the type of loads you want—whether target, plinking or hunting loads—and how to keep track of your work. Every load you assemble should be carefully listed and recorded. Your inaccurate loads are fully as important as those which perform in accordance with your wildest hopes. As a matter of fact, they are *more* important. If you note them down carefully and completely you can prevent a lot of grief through repeating the same mistake at a later time.

II

EQUIPMENT, FIXTURES, SUPPLIES

THE chap who desires to handload his ammunition would do well indeed to plan out the equipment in accordance with the facilities at his disposal plus the contents of his pocketbook. If he has an attic or dry cellar available—or even a spare room which he can turn into a combined workshop and laboratory—he can install more equipment than might otherwise be possible if he finds it necessary to limit himself to a single corner of his bedroom.

Bench loading equipment is always more desirable than the so-called "portable" equipment, particularly from the standpoint of performance. However, it should be solidly mounted, thus eliminating the necessity of tearing it down and putting it away each time it is used. Thus arises the problem of space. A loading bench should by all means be prepared.

A friend of mine, greatly limited in space facilities and forced to do his loading in his bedroom, solved the problem quite effectively through the manufacture of a four-foot portable bench. He built this with sturdy 4 x 4 birch legs reinforced from several directions underneath to make it absolutely rigid. At the same time the shelf beneath the bench has sufficient space to allow the loader to sit close to it and slide his knees and feet beneath it. This is important if you do not wish to work standing up. The height of the bench is also controlled by your desire to work standing up or sitting down. The top of this bench is made of two-inch planks of soft pine carefully planed, and fitted tightly together. This enables the worker to attach any equipment by means of screws. Certain places around the edge are, however, "relieved" so that powder-measure and other clamps designed to handle only one-inch stock can be made to function on this table. A four-inch birch apron beneath the table top also serves to strengthen it and protect it from undue stress.

In constructing my friend's bench the designer bore in mind that the use of it for the purpose intended would be inclined to pull it apart or at least loosen the various joints. He accordingly built it to stay, using no nails in the construction. Screws of proper size to carry these strains and properly located would and did do the trick exceptionally well. It has served him now for several years, and although its original coat of paint is somewhat scarred, it is today as sturdy as when constructed.

This table is stored in a secluded corner of my friend's back hall and is brought in for use whenever he reloads. Although reasonably heavy, one man can handle it quite comfortably, and it is of proper width to go through a two-foot-six-inch door with reasonable ease. The gun bug who has facilities for a permanent installation can build an even sturdier bench. The more weight he can put into it the more vibration-free it will become. A special room also eliminates the problem of storage of components and tools, as the tools may be installed semi-permanently on the bench and suitable cabinets constructed to hold powders, cases, and bullets.

If electric lights are available it would be wise to wire in an outlet at the rear of your loading bench. A desk lamp of the so-called gooseneck variety is highly useful, as it will permit the concentration of light upon the work at hand; it is a very easy matter to inspect your loaded cartridges during the various steps if a lamp of this type is used. If the operations of handloading are simplified as much as possible, the process will not only be easy but far more productive of satisfactory results. The energetic and resourceful handloader will continually find new ideas to be applied to his particular handloading problems.

To handload your ammunition properly you should have some form of loading bench. This may be a table, an old bureau or a suitably constructed bench. If possible, it should be about five feet long, and the heavier the better. A heavy bench does not jar as readily as the lighter types. Another thing: Some handloading fans prefer to do all precision work standing, while others are inclined to use a chair. The height of your bench depends partially upon your preference in this matter. In a custom-built rifle stock, a big man with heavy shoulders, long arms and generally large frame, requires a set of stock dimensions quite different from those required by a short man. This makes another restriction in bench sizes. A height which is satisfactory for some men to work at would be a bit too high or a bit too low for

others. If you build a bench, build it a bit too high and construct it so that the legs can be sawed off ¼ inch or so at a time until you get a comfortable and satisfactory height.

If a bench is constructed, use a hard wood top in preference to soft wood if it is available. This in itself will add weight. Make your bench top as thick as possible. The author uses a bench with a two-inch top. On the other hand, it is interesting to note that most of the bench-attaching tools,

An extremely useful accessory for examining bullets, bullet bases and primers—a regular fingerprint glass. The above is made by Bausch & Lomb, but the Spencer Lens Company makes a very similar model. These glasses have about a three-power magnification and an extremely wide flat field

such as powder measures and other clamp-on instruments, will not fit a bench top much thicker than 1½ inches and some will not go beyond 1¼ inches. I solve this problem by using a one-inch oak board about one foot long. My bench top has quarter-inch holes drilled at various locations and 3½-inch quarter-inch carriage bolts with suitable flat washers and wing nuts permit easy attaching to this board with an end-grain overhang of approximately 2 inches. It is a matter of but a moment to bolt down this board. The powder measures and other pieces of equipment are readily clamped to the overhanging end.

As a handloader gathers in new tools and equipment, he will find his bench rapidly becoming too small to permit of proper mounting and elbow room for his various equipment. Again this is readily overcome by drilling the bench top with quarter-inch holes in the desired positions. Bench tools may be quickly bolted down by means of carriage bolts and wing nuts. If one desires to use the bench for special work, it is a matter of but a few moments to clear off a series of bolted-down tools. This also insures rigid mounting—far more rigid than even heavy screws will give.

Small tool dies and other accessories should not be carelessly scattered; otherwise many moments are wasted in looking for them, only to find that something has been damaged or is missing entirely. It is far better to install your own "filing system." One of the most useful ideas the author has acquired was picked up many years ago from a handloader whose name unfortunately has been forgotten. This chap visits Skeet shooting clubs regularly and gathers in empty 12-gauge shell boxes—the older style two-piece variety with a cover sliding over the bottom. Unfortunately most makers of shells are gradually abandoning this particular type of box in favor of the one-piece variety, which is useless.

If you can gather in a quantity of these empty shell boxes, by all means do so. You cannot get too many. I use 200 of them continually. I am not particular about the brand, but insist that they all be 12-gauge, since that is the size easiest to locate and at the same time permits of extremely uniform stacking. A roll of 2-inch Plain Kraft gummed tape can be purchased for about a quarter. This will last many years. Gummed tape makes excellent labeling material. The ends of the boxes should be properly pasted over with a piece of 2-inch tape approximately 3½ inches long. On this, with a heavy blue or black wax pencil, one can label the contents of the box. A few properly built shelves will accommodate a great many of these boxes. One chap even has a gun club save empty 12-gauge shell cases for him. He nails the cover on the case and then saws horizontally through the center, giving him two half-cases. Several of these are nailed together, the nails being clinched to prevent their working loose.

When split in this fashion the shell cases measure outside 9 x 14½ inches and are 4¾ inches deep. My friend has built himself a frame or "open face cabinet" three boxes high and five boxes wide. The height of this cabinet is approximately 44 inches and the width is 45 inches. The entire unit is attached to the wall by means of screws to prevent it from falling over. This cabinet will hold ten boxes in each compartment and allows room in the 15 compartments for 150 shell boxes. The end labels in this loading room show that one section is devoted to dies and attachments for dif-

ferent tools and in the various calibers for which my friend loads. Others are devoted to shells and primers, and his bottom center section contains nothing but bullets. To remove any desired box, he simply slides it out of the stack, occasionally finding it necessary to lift out the three or four boxes above it. In the lower right hand corners of all the front labels he has numbers running from 1 to 150 which indicate the location of the boxes, so that should he remove several of them he can quickly return them to their proper places.

This system also permits of changing the end label regularly when the boxes are desired for another purpose. In looking over this friend's group, which is patterned on the same idea as my own, we find a great many empty boxes. These are used for special purposes. Various makes of shells may be properly separated, while the end label indicates resized and primed shells and those which have not as yet been run through the loading tool. Thus his small equipment and components are at all times free from dust and dirt, a very valuable feature.

For the beginner in handloading certain equipment is absolutely necessary. He must, however, confine himself to the bare essentials for his preliminary work. As he grows up in the game his ideas will change—and so will his equipment. Skill is necessary, but skill is not acquired through the reading of books and literature. The essentials are some form of loading tool or equipment, including shell resizing dies, decappers and a priming device, some form of powder measure or balance to weigh out charges, and a suitable bullet seater. If the handloader desires to make his own bullets, casting equipment is necessary. This calls for bullet moulds, a cast-iron melting pot, and a pouring ladle with a snout shaped to fit the sprue cutter of the bullet mould. A casting machine such as is described elsewhere in this volume may be substituted for this equipment.

A good loading bench is extremely useful. The above bench in the author's laboratory was made of ¾-inch iron pipe with a 2-inch birch top. The various tools may be used in any position, as they are attached to the bench with carriage bolts and wing nuts. The 12 gauge boxes in background are extremely useful to hold various change-over dies

It is not necessary to have a wide assortment of powders if one intends to load for just one or two cartridges. For handgun cartridges one may use a single powder for all normal loadings. One may choose any of the current powders for that purpose—Hercules Bullseye, Du Pont Pistol #5, Pistol #6 or Sporting Rifle #80. It is not necessary to have all of these. A single powder will serve the purpose well, the powder of course depending upon the particular cartridge to be reloaded. One of the Du Pont IMR series or one of the Hercules rifle powders will take care of many rifle loads. Most handloaders, however, use many different powders; but the knowledge of these is something one acquires with experience.

It should not be necessary for the reloader to make a diligent search through his "collection" to

locate a particular package of components when they are needed. If a loose-leaf notebook is used to keep loading data it should be of a large size—preferably about 8½ x 11 (letter size). A section of this can be devoted to an inventory of components, and if this inventory is properly kept it may save the reloader some embarrassing moments when supplies are needed.

Only last evening the extension telephone in my laboratory jangled harshly while I was in the midst of preparing some experimental handgun loads for velocity and pressure tests. I resented the intrusion but answered pleasantly. "Phil," came a plaintive voice over the wire, "I am just loading up some .38 Specials to use in Friday evening's match and discover that I haven't any more Winchester #111 primers. Can you lend me 100 if I come right over after them?" If a "live" inventory is kept the reloader will always know when his stock of any particular item is running low and will thus be able to replenish this in time to avoid such embarrassing situations

Each inventory sheet should be devoted to but a single item. If you use ten different kinds and makes of primers, use ten different sheets for listing. A low-priced "Hectograph" or gelatin duplicator obtainable from office-supply houses or from mail-order houses for less than $2.00 is extremely useful in duplicating your various notebook pages in quantity. If you have a typewriter you may purchase for about half-a-dollar a regular "Hectograph" ribbon which may be installed instantly and used to prepare your master form. A new master form must be used each time, but with a good duplicator at least one hundred clean reproductions can be made from a single master copy; often twice that number.

It is important that the lot numbers, if any, shall be recorded on your inventory sheet. A brief memo as to the cost and the shipping charges is also useful in figuring the exact expense of ammunition.

A number of other pieces of equipment are more or less necessary for satisfactory handloading. A very useful accessory is a vise. This should be at least medium size, not a delicate affair that can't stand abuse. A medium-weight vise costing $3.00 or $4.00 will outlast a dozen $2.00 vises. One should get the swivel type if possible and mount it on one corner of the loading bench. It will prove useful, with suitable jaws, to hold a rifle during the cleaning operation, supporting the stock portion in the vicinity of the magazine. The muzzle can be propped up on some form of muzzle rest. The National Target and Supply Company in Washington has a line of these special vises for sale to shooters; but it is not necessary to go to the expense of purchasing this equipment, as the average handloader will be sufficiently resourceful to develop his own accessories of this nature.

If you use a vise, get a series of jaws of lead, copper, and steel. Useful jaws can also be manufactured of soft pine and built to slip over the regular steel jaws. With slight form-fitting indentations, the wood jaws can be made to properly grip bullets for special purposes. One reloader even goes so far as to use a vise for bullet pulling. This is not to be recommended, however.

Another useful accessory is a small anvil. The heavy type is of no particular value, but a number of lightweight anvils weighing from five to eight pounds can be obtained from various sources. Sears, Roebuck and Company have one which they sell for 85 cents and which weighs eight pounds.

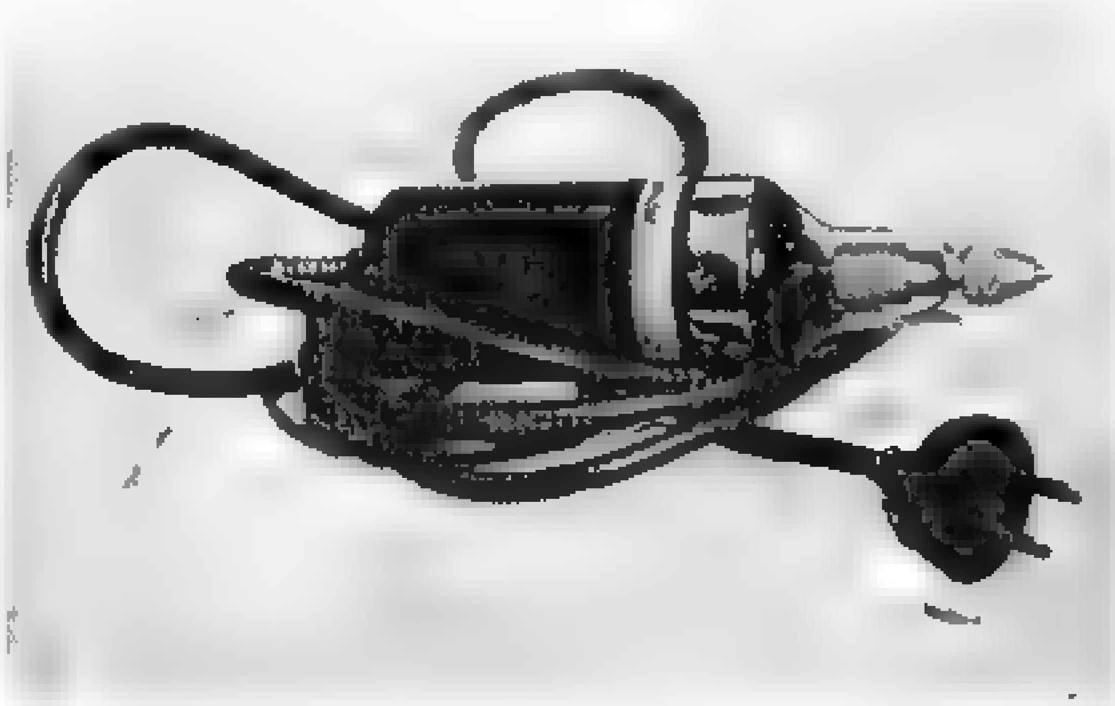
PRIMER INVENTORY

MAKE *Remington* **No.** 1½ **DIAM.** .175 **TYPE** *NCNF* **CTG.** *.38 Spl etc.*

Received						Consumed					
Date	Quantity	Lot No.	Cost	Shipping Charges	Rec'd from	Date	Quantity Used	Lot No.	Ctg.	On hand	Remarks
1934											
Feb. 16	2,000	4,071	7 20	.39	Fact.	Feb. 17	100	4,071	.38 Spl.	1,900	
						27	150	4,071	38/44	1,750	
						Mar. 1	300	4,071	......	1,450	To J C. W.
						May 15	200	4,071	.38 Spl	1,250	
						15	50	4,071	.38 ACP	1,200	
						July 1	200	4,071	38/44	1,000	
						19	200	4,071	38/Sp.	800	
						26	50	4,071	.38 Sp.	750	
						Aug. 5	300	4,071	......	450	To E. C. D.
Sept. 7	1,000	4,123	3.60		E. & W.	Sep. 4	100	4,071	.38 Sp.	350	
						7	200	4,071	38 Sp.	150	
						22	150	4,071	.38 Sp.	Gone	
						Nov. 2	100	4,123	38 Sp.	900	

It is sufficiently light to permit of moving it around properly on the bench, yet heavy enough for all types of experimental work. Do not use the anvil built into a great many vises; continued use merely mutilates the vise.

Among the special items of considerable value to any handloader is a very simple one—a scrap box. This should be reasonably large, tight enough to be dust-proof so that it does not spill its



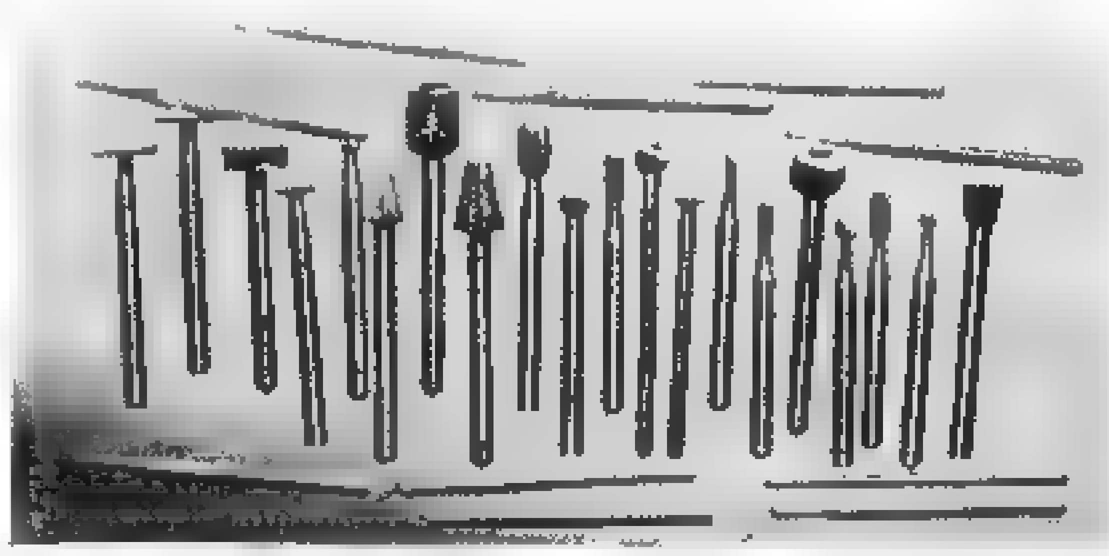
The Handee Grinder is comfortable in the hands and with a small brush, either of animal bristles or soft bronze wire, primer pockets may be cleared almost instantaneously of their caked-on debris

contents on the floor, and sturdy enough to stand long service. The author uses an empty 12-gauge shot-shell case. If you mutilate a shell or a primer, do not lay it aside, but toss it immediately into the scrap box. Plan never to use anything thrown into that scrap box. If I find a shell to be slightly defective, I merely lay it over a small anvil and rap it lightly with a hammer, thus mutilating it beyond hope of salvage. This, at the same time, is a positive identification and prevents the shell from getting mixed with others of quality. Fired primers from continued loading operations can be scooped up and tossed into this scrap box, as can the various miscellaneous pieces of débris and equipment of no value that the handloader desires to discard. Whenever necessary, it can be emptied, but care should be taken to see that its contents are dumped where they can do no harm. Such a scrap box very frequently contains live primers, and under certain conditions these can be dangerous.

This live primer proposition is extremely important. Primers are cheap, and no attempt should be made to salvage them under any conditions. If a primer is decapped from the shell, it should be thrown away, *never reused*. Also if, in tidying up your loading bench at frequent intervals, you find a few stray primers, do not attempt to identify these, but throw them into the scrap box. They may be primers from a box on your shelf or they may be strange numbers decapped from some shell which you were investigating.

There should be a suitable place on your work bench for various kinds of oil. You will need a light penetrating oil, a heavy gun oil, and a medium gun oil. There should be containers of powdered graphite and graphite grease. From time to time you will find a great many demands for a particular body of oil, and unless the proper oil is available you will be inclined to use anything else that is handy. The operation of loading tools very frequently calls for the use of oil. Light oil works best in some places, heavy oil in others, and in still others a very thin penetrating oil dished out a drop at a time serves the purpose far more satisfactorily than heavy oil possibly could.

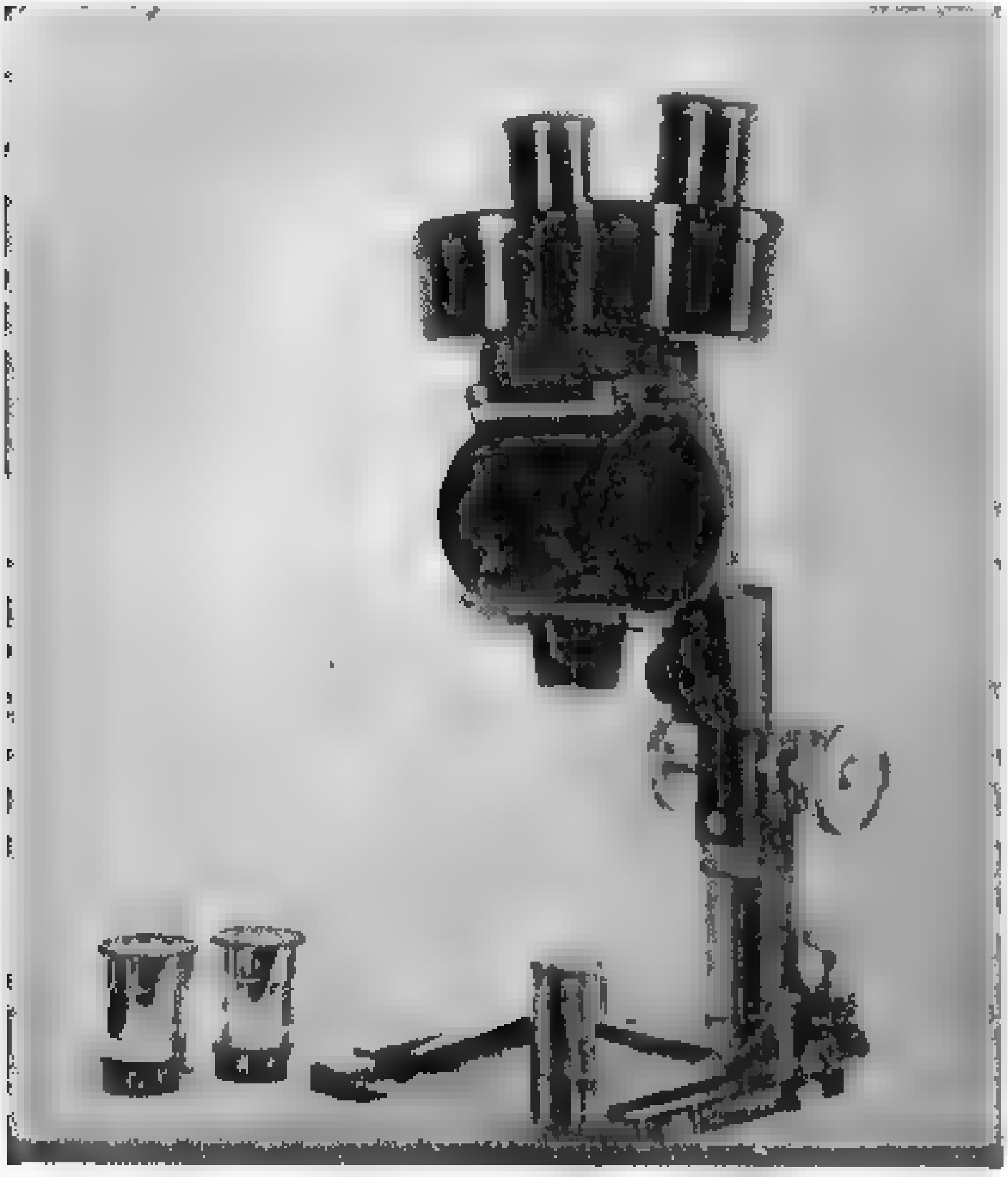
The handloader's equipment also requires a large assortment of screwdrivers. Expensive screwdrivers are not necessary, but the blades should be of reasonable-quality steel properly touched up. The intelligent handloader does not use his screwdrivers as they come from the store, but reworks them to suit his own particular purpose. For this, a portable grinder is of extreme value. The grinders today are not the expensive pieces of equipment that they formerly were. A quarter-horse ballbearing motor, complete with two grinding wheels and proper wheel guards, can be purchased new for around \$12. A bronze bearing similar job costs \$10. These are high-speed units, turning over



A few of the burrs and milling cutters available for use with the Handee Grinder. These greatly simplify many of the odd jobs and tricks the handloader is called upon to do

at about 3450 R.P.M. With such a grinder, one can quickly reshape his screwdriver to suit his particular needs. It is often wise to cut the blade off rather short and then regrind it to fit particular screws. It is much easier to control a short stubby screwdriver than a long slender one. After grinding the screwdriver to shape, it should be heated to a dull cherry red in a coal or gas flame and then quenched in water. This makes it extremely hard.

It is then heated once again until a light straw color appears, whereupon it is set aside to cool. This gives a proper spring temper to prevent breaking. When it is necessary to regrind your screwdriver, it isn't necessary to retemper it if



The handloader who can afford elaborate equipment will find the Bausch & Lomb AKW-5 Wide Field binocular microscope of low power to be valuable in his research. Rotating the objective drum will change the magnification without changing the focus. Two cartridge cases can be compared and primer defects studied readily with this instrument

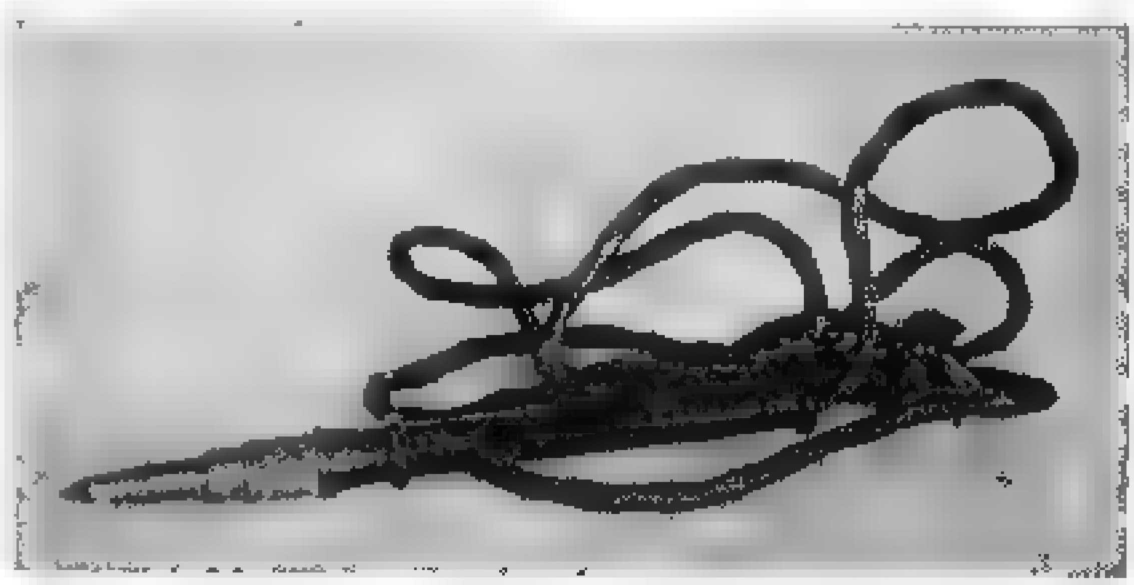
proper care is taken. Grind slowly and quench the tool at frequent intervals in a dish of water kept beside the grinder. Be careful not to burn the point. If the point or blade portion suddenly turns blue the temper has been drawn from it and must be done over again, otherwise the edge will twist off the blade in service.

If you have one of these portable grinders, it is possible to obtain a series of cloth buffing wheels at an extremely low price. These wheels can be obtained for a few cents each, and a plentiful supply should be kept on hand. They are handy for cleaning the outside of cartridge cases—also loaded cartridges. Particularly where lubricated cast bullets are used, the handloader notices that his completed ammunition is somewhat greasy. This surplus grease gets over the case neck and the bullet but can be wiped off by means of a rag if the handloader desires his ammunition to look finished. A cloth buffing wheel will cut down this wiping time to a small fraction of that required when the job is done by hand. These wheels can be washed when they become too greasy by soaking them lightly in gasoline, rinsing carefully, and setting them outdoors to dry. If the handloader does not have a suitable buffing unit available, he can simplify the task of cleaning this surplus grease by using a small amount of gasoline on his rag. Bullet lubricant wipes off slowly and requires much effort if a dry rag is used. If possible, do this job in the open air to keep the gasoline fumes out of the house. A few drops of gasoline on a clean rag, replenished at frequent intervals, enable one to wipe loaded cartridges at the rate of seven or eight per minute, and frequently faster than that. Do not immerse your cartridges in gasoline, however. It is permissible to dip the bullet ends gently in gasoline and wipe them immediately.

There is no such thing as "complete" loading equipment. Every handloader continues throughout the years to add to his stock. Summed up, however, the essentials of the handloader are contained in the following fifteen items:

1. Loading room. A suitable loading room equipped with bench, storage facilities for powders, primers, cases, bullets, and loaded cartridges, satisfactorily inventoried; together with storage facilities for loading tools and other accessories.

2. Loading tool. A complete loading tool with full-length case resizing dies *plus* neck resizing dies only. There will be plenty of times when the shooter will not desire a full-length resized cartridge case, particularly for his precision target ammunition.

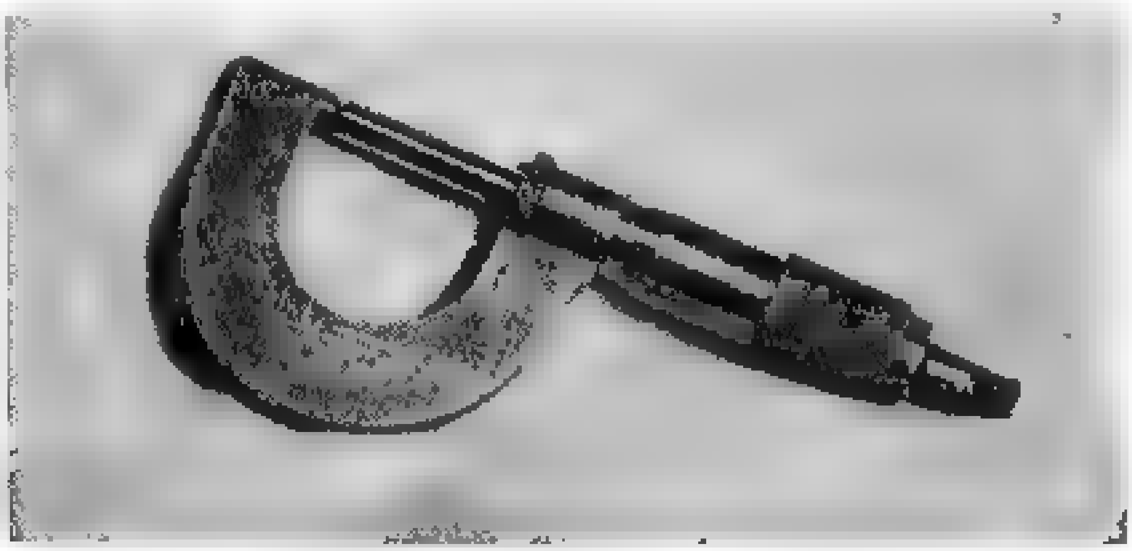


A Pyro pencil is a very useful item. Although made for burning designs on wood, it may be used for a multitude of purposes, even serving as a soldering iron with its extremely sharp and well-shaped point

3. Powder balance. Some form of powder balance with an accuracy of better than 1/10 grain. For the man who desires precision loads, this balance must show a sensitivity of at least 1/65 of a grain. The more accurate the balance and the

reloader's weights the more uniform will be the charges he runs into his case. It is, of course, *uniformity* which spells consistent accuracy better than any other one item in handloading.

4. Powder measure. A powder measure is extremely practical and quite useful. It should never be used for maximum loads, and I say this without reservation. I have seen some truly dangerous



A good micrometer is an absolute necessity to the chap who wants precision loading. It can be used to check bullets and case diameters quickly and for all outside measurements. Generally speaking, a one-inch capacity instrument is sufficient to take care of the handloader's needs. These tools are not expensive. The above Starrett #113 has been used by the author for more than fifteen years

loads assembled merely because maximum charges were run through a powder measure. Medium and standard powder loads, particularly for handgun target shooting, can be readily and accurately assembled with a good powder measure properly handled.

5. Bullet moulds. Not necessary for reloading, as you can buy standard factory bullets of practically every type, all assembled, resized and lubricated. To the chap, however, who enjoys bullet casting and experimenting with various alloys, proper moulds are in order.

6. Bullet sizing dies. These are necessary to the man who casts his bullets. They are of no use to those who use cast bullets bought from a reliable source, or who use factory lead or jacketed types.

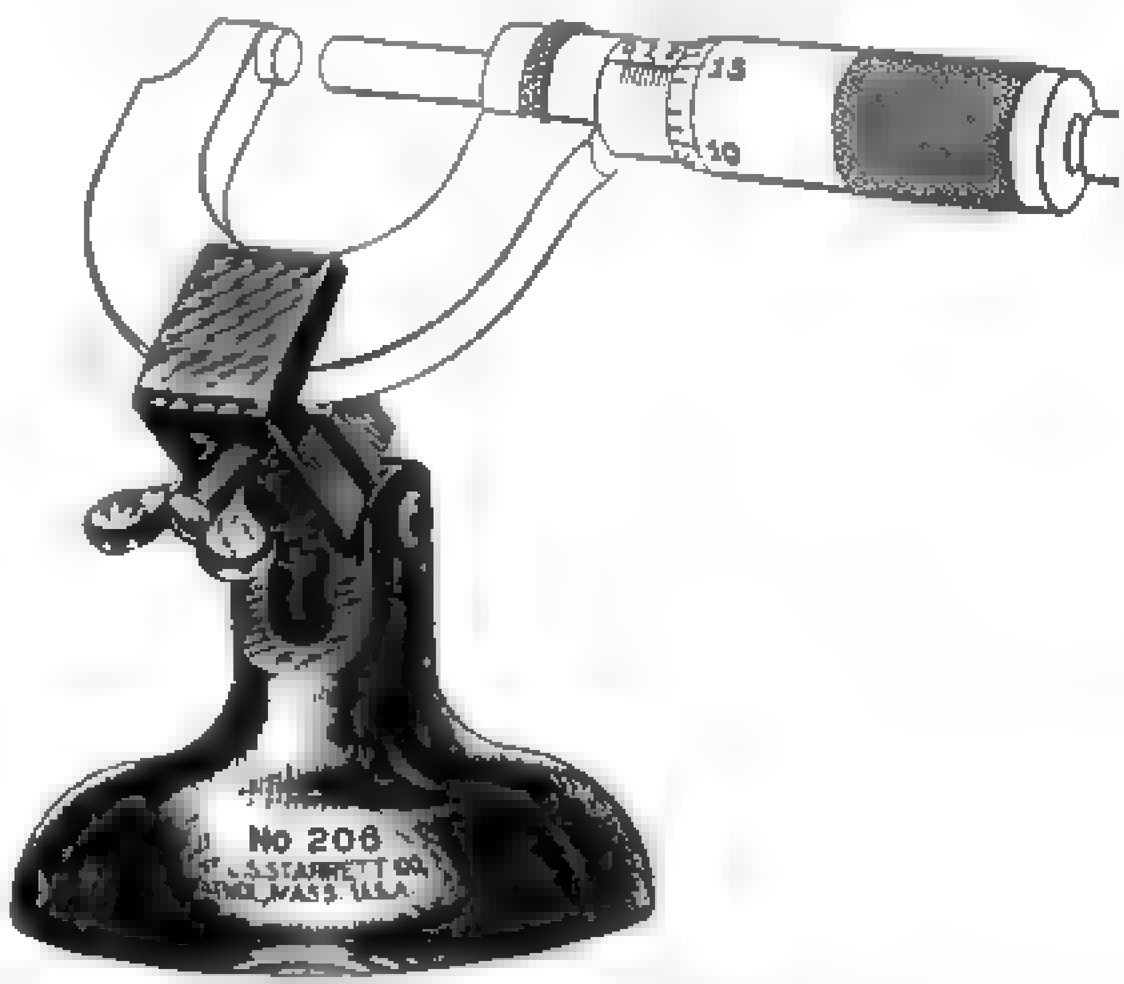
7. Bullet lubricators. These are not necessary to the man who does not cast bullets, but some form of lubricator will be exceedingly practical for the experimenter who pours his own.

8. Powders. The true gun bug uses several different types of powders, depending entirely upon the load he seeks or the results expected. No one powder can be made to handle properly everything from reduced loads to full power charges. The kind of powder to be kept on hand is controlled entirely by the shooter's reloading intentions.

9. Primers. This subject is far more vital than the average reloader believes. In this day there is little if any excuse for using the old style of corrosive priming. The non-corrosive types are available for every cartridge, and a plentiful supply should be kept on hand. At the same time the loader who desires to save on his expense may use Frankford Arsenal #70 primers. This is an old style chlorate non-mercuric type, but extreme care must be taken in using it and the bore always cleaned properly after firing. Every batch of such ammunition should be labeled "Poison" with a further marking to indicate the corrosive type of priming.

10. Factory bullets. This item includes a plentiful supply of either factory lead or jacketed bullets in the calibers desired.

11. Cases. A plentiful supply of empty cartridge cases must always be kept on hand. Very frequently the reloading bug discovers to his sorrow that he desires to assemble for a definite purpose some particular combination of components, only to find that all cartridge cases in that caliber have been loaded. The loading bug doesn't always assemble cartridges merely to get something to shoot—he builds them for a particular purpose,



A micrometer stand is a very useful, although not absolutely necessary, item. This can be adjusted to hold a micrometer at any angle, thus allowing both hands for the work. Bullet diameters may be quickly checked by using the right hand to operate the spindle and the left hand to hold bullets

and 500 full-charge target loads sitting on the shelf, precision-loaded, will not be of value in case he desires to load 25 or 50 cast bullets for 50-yard target work, or a similar quantity of high-speed varmint cartridges to take care of a day's proposed sojourn in the field.

12. Loading data. This kind of data in printed form should always be kept available in the vicin-

ity of the loading room. It should include all available data upon the subject plus a well-kept record book giving actual results of special handloaded cartridges. There should also be a *live* inventory of supplies on hand.

13. Powder Storage. This subject is of extreme importance. While it is necessary for the handloader to accumulate reasonable quantities of powder, he should never store more than one cannister of each type in his loading room. Suitable safe facilities (to be discussed later) should be available for proper storage of surplus quantities.

14. Patience. This is an intangible thing, but it is vitally important that every handloading fan acquire a plentiful supply of it and keep it available at all times. Lack of patience in handloading will result in poor ammunition and, not infrequently, extreme danger.

15. Intelligence. This is closely related to the subject of the preceding paragraph. The average chap who desires to handload his ammunition is more inclined to be an intelligent sort of person than the ordinary individual who is content to use nothing but factory-assembled loads. This is not a reflection on the intelligence of the reader, but merely a suggestion that he acquaint himself with some very important factors in handloading—possibly foreign to the assembly of loaded cartridges—such as the mechanical limitations of the guns in which they are to be used.

The reloader should know how much his gun can stand, and it is decidedly unwise to use "poison" loads of extreme pressure in order to find the answers. He should learn the restrictions of bore size, requirements of cases, balance between powder and bullet, and many similar things.

III

THE CARTRIDGE CASE—ITS DEVELOPMENT AND MANUFACTURE

THE major idea back of handloading is the saving of the shooter's ammunition dollar. And the conservation of this means the salvage of the most expensive part of a cartridge—the brass case. In truth, the empty brass cartridge case costs more to manufacture than any other component, and one can safely assume that it costs its makers *more than all other components put together.* It has a useful life, with ordinary care, of from ten to fifty reloadings. Why, therefore, should it be relegated to the junk heap as "fired" after being used but once? The handloading fan regards this unnecessary waste of good brass much the same as he does the buying of a suit for a special occasion—wearing it once, and then turning it over to the moths.

A thorough understanding of the history of the cartridge case, together with its method of manufacture today, will enable the handloader to better understand the problems of the cartridge-case manufacturer, and enable him to get the greatest life out of his "empties."

Unfortunately, history does not give us authentic records of the historical development of ammunition any more than it enables us to trace the development of the rifle with any degree of accuracy. It is believed, however, that good old King Gustavus Adolphus of Sweden started things along these lines in the early 1600's when he ordered his soldiers to carry their powder and ball together in the form of a "cartridge." This was generally a cylinder of paper, twisted on both ends, with the round lead ball in one end and the measured charge of black powder poured in on top of it. In use, the troops bit or tore off the powder end of the tube, poured the shiny grains into the mouth of the old smoke-stick, dropped the ball in on top, and then hammered the mass tight with the ramrod. Here is where the title "ramrod" came into being. It wasn't essentially a "cleaning rod" as we know it today, although it did serve that purpose. The rod was a rammer, and usually had a conical or cup end to fit the general contour of the ball or bullet. The other end often had a screw or auger point, with a slot back of the point. The auger arrangement was used to draw an unfired charge—its screw point was turned into the soft lead ball and wads, in case the shooter desired to unload his gun without firing. The slot made the ramrod a "cleaning rod." . . .

There was no real development of the cartridge, however, until the Rev. Alexander John Forsyth, a Scotch clergyman, invented the percussion mixture known as "fulminate of mercury." Forsyth did not actually invent this chemical compound; it was known for several years, but he first applied it to the ignition of powder charges, and thereby won eternal fame. The complete record of primer developments is contained in the chapters on Primers and will not be repeated here.

Many attempts in all countries to experiment with "cartridges" met with mediocre results until Dreyse introduced the famous "needle gun" into the Prussian Army in 1842. This arm had its own means of ignition, in which the fulminate was contained in a cap in the base of the wad used to separate powder charge and bullet. The "firing pin" was a long sharp needle which penetrated through the entire powder charge and detonated the mixture in the cap. Paper was used for the "cartridge case" and later this was changed to oiled linen and, on occasion, oiled silk.

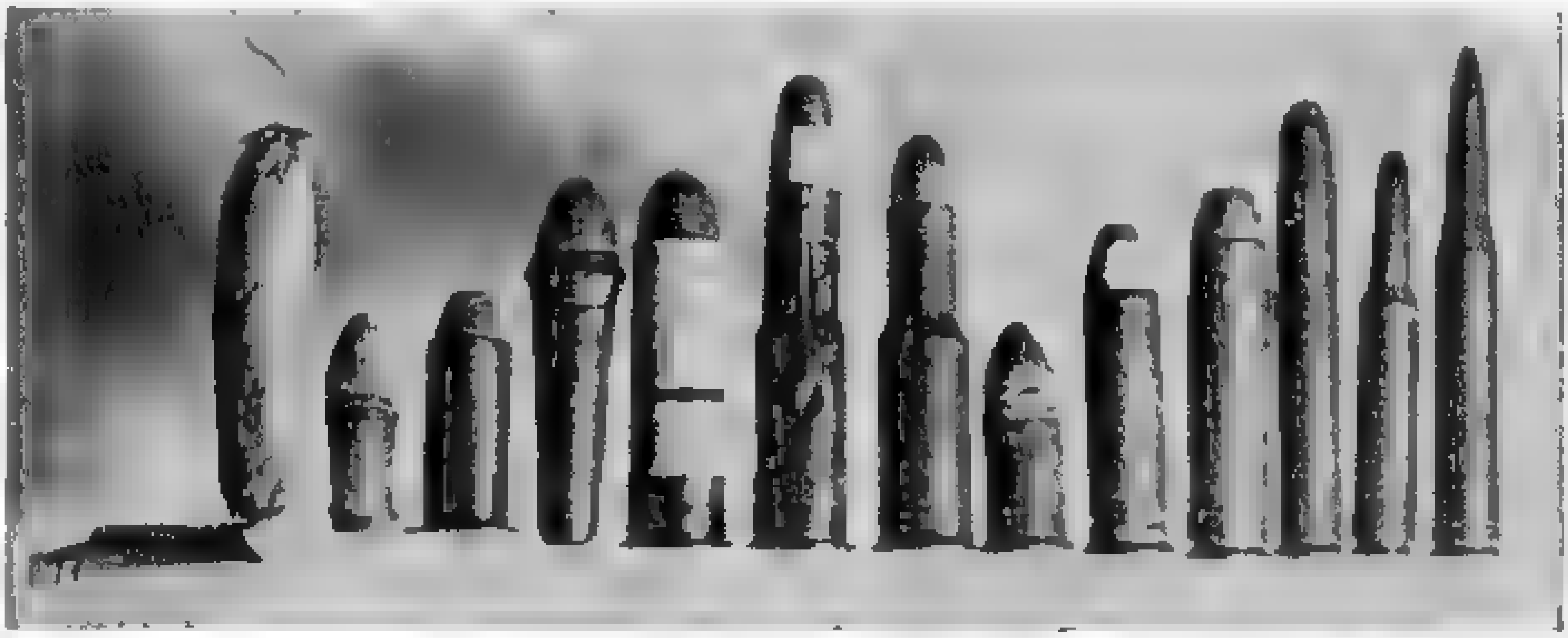
In America, brass cartridges came into being at an early date. Maynard was among the first to manufacture these—with Burnside, Sharps and a few others. Maynard brought out the tape primer in 1845—an automatic lock arrangement feeding a roll of paper caps to the nipple of the gun each time the lock was cocked. The idea back of this was almost identical with its present use—so-called "cap pistols" used by the youth of America on holidays for celebration purposes. This primer came first, and in 1851 Maynard patented his famous brass cartridge. This was a tubular brass case with a wide flat base soldered to the body. The center of the case was perforated with a needle hole, and the case was used in conjunction with the Maynard tape primer.

My first "collection" cartridge was a Maynard—and we had several of them. One was given to another youngster, and although this happened more than a quarter of a century ago, the details are still vivid. We were out "hunting" with .22 rifles, and as youngsters will, we figured that a

campfire would be useful. There was plenty of material for a fire, and we had matches—of the old "sulphur type." However, we had nothing to strike these matches on; so my companion dug this big Maynard cartridge from his pocket and scratched the match across the wide, flat brass head, all before I could remonstrate. There was one terrific *boom* and a couple of scared kids began to take stock. That Maynard cartridge had exploded in my friend's hands without scratching or burning him. We spent a couple of hours looking for traces of it, but without success. . . .

Sharps rifles used linen cartridges—a linen envelope containing the charge of powder and the ball. In England, the Snider "coiled" cartridge came out, a brass and steel head with a body built up of thin brass foil and paper in layers. A strip of this paper-metal sandwich stock was coiled or rolled around an anvil and its edge glued solidly to form the coiled cartridge case. Strangely, Imperial Chemical Industries of Great Britain, the big combine that controls the ammunition industry over there, including Kynoch and Eley, still makes this coiled cartridge for the Snider. A few years ago when I inquired the reason for this, I was informed that it was much easier to make, therefore cheaper, and was strong enough for the low black powder loadings sold to natives in colonial possessions.

It seems that England is not anxious to have these natives armed with guns of modern nature, and this long-obsolete specimen of cartridge suits the needs of the ignorant subjects as well as the most modern of magnums. This .577 Snider cartridge came out about 1867 and was at that time the official arm of the British military forces. The British Small Arms Manual credits the Snider cartridge to the ingenuity of Colonel Boxer of the Royal Laboratory at Woolwich. (The Royal Laboratory is the official British ammunition factory, corresponding to Frankford Arsenal in this country.)



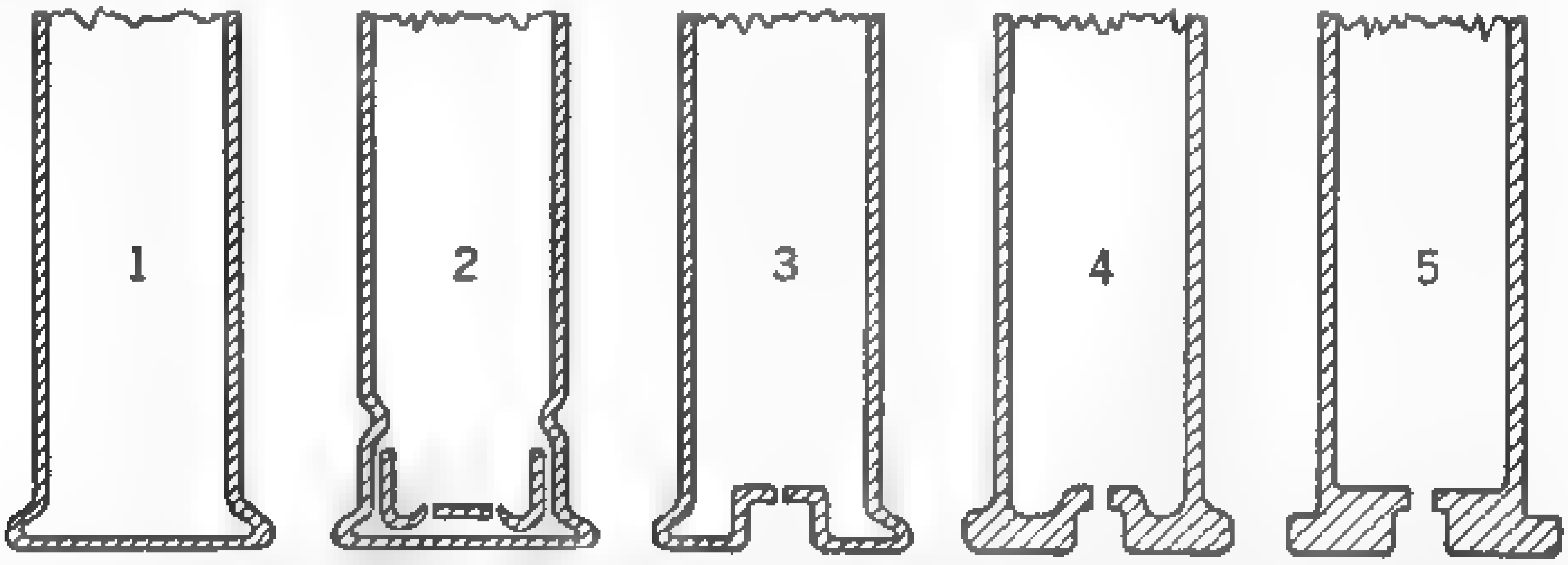
Evolution of the modern cartridge case. Left to right: The old paper cartridge for muzzle-loading percussion muskets; paper cartridge for Colt revolvers; the Maynard percussion rifle cartridge with wide thin rim soldered to base of shell, hole through the center admits flame from percussion cap; the Burnside percussion carbine, loaded from the front of the chamber, uses percussion caps; .577 Snider coiled cartridge case, case manufactured of three layers of sheet tin and paper, cemented together and rolled into shape, compound head built up and soldered on: the .577/450 Martini-Henry coiled case, case body made of soft brass, rolled and pressed into shape, can be readily mutilated with the fingers. Composite head soldered together and similarly attached, both of these coiled cartridges are centerfire numbers; solid drawn .577/450 Martini-Henry designed for same rifle, the .58 musket rimfire; .50/70 rifle, Springfield Armory make, with inside primer—looks like rimfire—identified by crimps on body near head; .50/115 Bullard centerfire with semi-rimmed head, one of the first of the semi-rimmed cases; .405 Winchester; .257 Roberts rimless; and last the .300 H. & H. Magnum belted head

In 1871 the Snider cartridge, as the official British caliber, was dropped in favor of the then-new .577/450 Martini-Henry, one of the first attempts in England at a bottle-neck cartridge. This case had a .577-caliber body necked down to hold a .45-caliber bullet; hence the complicated British title. Construction of this case followed that of the Snider except that no paper was used. Thin soft brass, together with a built-up head of combinations of brass and iron, formed this cartridge, which is distinctive in appearance. The Boxer-Snider looks like a paper tube cartridge built along the lines of the modern shotgun shell until one examines it closely and locates the layer of brass. The Martini-Henry does not use the coil of thin brass slashed off parallel with the axis of the bore, but instead angles up, much like the two-thickness paper bullet patch described later. It was built over a mandrel similar to a .577 caliber, and then necked by wrinkling it (see illustration). Oddly,

too, this cartridge still remains one of the standards among the British ammunition makers' numbers, since it is cheaper to manufacture, despite the fact that Kynoch manufactures both the Snider and Martini-Henry in solid drawn brass cases as well as the "coiled" form. The early Mauser rifles also used the Snider type of coiled cartridge.

In America, the coiled case was never popular. Drawn brass cases came into being early with the advent of the Civil War. Burnside developed a cartridge of drawn brass which was inserted in the breech block of his rifle base first from the *front* of the "chamber." This tapering cartridge was much smaller at the rear than at the front, and had a waist about an eighth of an inch from the mouth of the shell to act as a bullet stop. The mouth was then deeply crimped to the bullet to lock it solidly in position. Many old-timers, in discussing this rifle and cartridge, have told me that the crimp tore the mouth off the brass case, the band of brass clinging solidly to the bullet in flight. Never having shot a Burnside, I took this description with the professional "grain of salt" until early in 1935, when a worker at Coulee Dam, operating a dredge, sent through a batch of four or five bullets brought up from a river bottom by his dredge. These were well weathered, but unmistakably from Burnside carbines, and remains of the brass "crimp" were found circling the bases of practically all bullets. My correspondent stated that he had brought up some two dozen lead bullets, mostly these Burnsides, although many were round balls, thus indicating that at some time the river had been the scene of a battle, probably between the U. S. Cavalry and Indians.

The rimfire cartridge was the first truly successful cartridge, in that it was fairly moisture-proof and at the same time was entirely self-contained, its three major components—powder, primer and bullet—being combined into a single unit by means of a copper case. Burnside, Maynard, Sharps, and other inventors had depended on some form of percussion cap together with a cartridge case containing only powder and ball, and ignited through an opening in the head of the cases. Flobert in France pioneered his "BB Caps" (Bullet Breach Caps), but Smith & Wesson developed the first successful rimfire cartridge in this country in the now common .22 Short, first produced for revolvers in the spring of 1858. The rimfire as made then was essentially the same as that manufactured today; a copper disc was punched out of sheet metal, drawn into a closed end tube, and the rim bumped on it. This hollow rim was filled with the fulminate of mercury mixture and exploded when the rim was pinched between the face of the chamber and the firing pin or hammer nose, igniting the charge of powder. Henry adapted this .22 rimfire to a larger size and brought out the famous .44 Henry Flat rifle, the first successful magazine arm, later known as the Model 1866 Winchester, and the Spencer series of rimfire bottle-necks.



Evolution of the cartridge case: (1) rimfire; (2) inside Martin cup primer showing method of construction, twin flash holes used; (3) the original folded head cartridge; (4) the original solid-head cartridge case now known as the semi-balloon primer pocket. Note how primer pocket projects into the powder cavity; (5) modern solid-head, solid-web type of cartridge case. Much stronger and better adapted for high-pressure loading. Rapidly forcing No. 4 into the discard

Ammunition progress was making rapid strides about this time. Soon centerfire cartridges began to make themselves prominent, the earlier forms of these being the "inside primer" types as made by several American commercial firms and by Frankford Arsenal for use by military forces. The inside primer was preceded by a number of early attempts at combining the primer with the cartridge case in a single unit. The following information on primers was obtained from Frankford Arsenal by checking Ordnance Memoranda #8 and #14, dated 1868 and 1873 respectively. Additional checks were made by consulting reports of the

Chief of Ordnance published yearly, which contain all operations of the department.

The earliest attempt at centerfire cartridge construction was known as the "Martin centerfire cartridge, caliber .50," and was invented by E. H. Martin. It was first manufactured experimentally at Springfield Armory in 1866. Frankford Arsenal received orders dated October 5, 1866, to start production of this cartridge. The first of these were manufactured with the bar anvil, an anvil or bar of tinned iron forced across the inside face of a rimfire cartridge and having the primer composition at the center. Several million rounds were manufactured up to March 1868, during which time the development had gone through several stages. At that time the cup anvil of Colonel Benét was adopted.

The evolution of Colonel Benét's type of primer was logical, in that the bar anvil was crimped and gave a case that was rigid in one direction but weak in the opposite. Also manufacturing problems arose with the bar type of anvil turning over during assembly, and thereby producing a misfire. Cases often blew out at the crimp until this was overcome by introducing a thin copper or brass cup to form a gas check. The double metal, of course, cut down the sensitivity of the primer. Subsequently, it was found that the bar and cup could be combined and a round anvil was produced which supported the entire head. This was made of heavy copper. This inside primer of Benét's had the appearance of a large rimfire, and in fact was first made as a modification of the .50/70-caliber government cartridge, which at one time was a rimfire. It was, of course, drawn exactly the same as a rimfire cartridge case, and an anvil of bar (and later cup) style containing priming composition in its center was pressed into the interior of the case. Two heavy crimps on opposite sides of the case approximately .1 inch from the rim held this cup in position.

I have shot a goodly number of these in years past, and to verify their construction, just as this is being written, I dissected a fired FA .45/70 inside central fire shell. The copper case is very thin, the walls being only .013. The reinforcement cup which also serves as the "primer" is made of much sturdier stock about .030 thick. On the base of this cup, which was inserted in the shell "mouth up," is a depression having a diameter of .175 inch (about the diameter of the present revolver and small rifle primer pockets). This depression was filled with the fulminate, and on either side of the "pocket" were two flash holes of a diameter approximating those in current use in today's American types of construction. The firing pin blow struck the center of the plain copper base shell, crushing the primer mixture between the shell head and the crimped-in cup. The resultant flash was transmitted to the powder charge through the flash holes. In shooting a batch of some fifty of these a couple of years ago, I did not have a single misfire, despite the fact that the ammunition was loaded nearly seventy years previous to the firing!

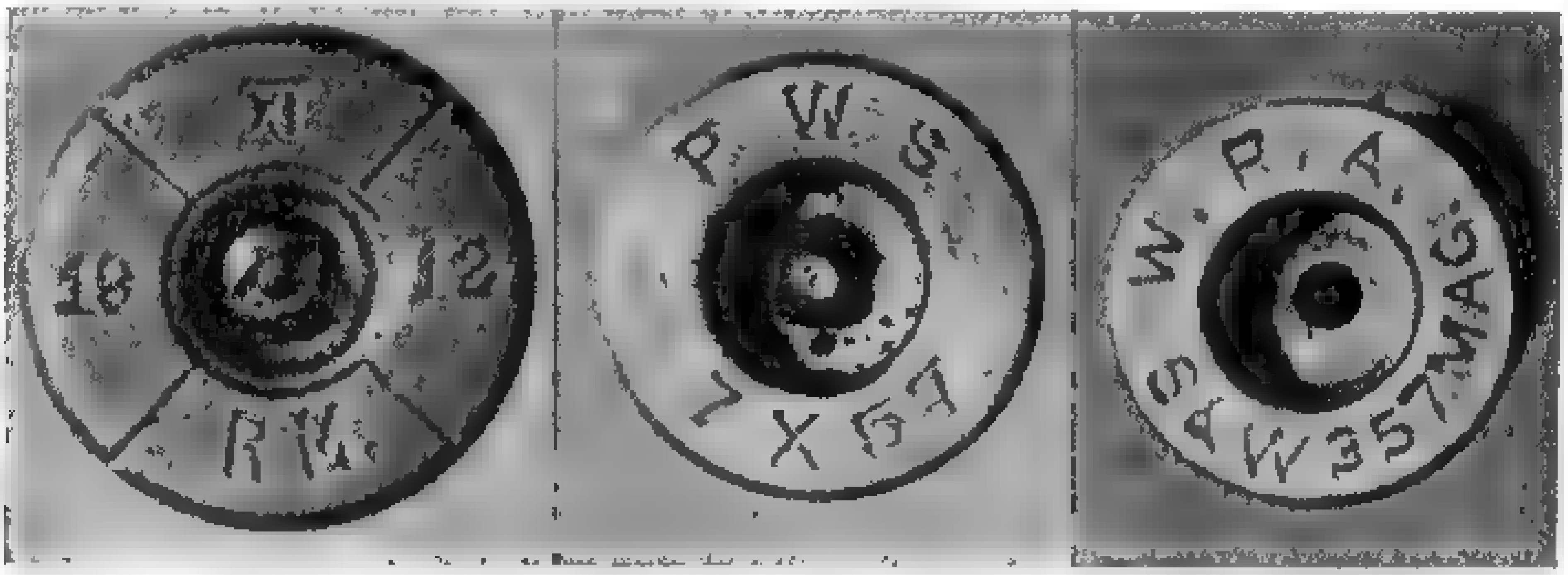
The Martin with folded-head cartridge was made under two different patents, although the government, as previously stated, began its manufacture in 1866 at Springfield Armory and Frankford. The first patent was granted in 1869 and consisted of a single fold. The second patent of 1870 covered a double fold. Manufacture was abandoned by the Government in December 1871. Although this primer was used chiefly in the .50/70's, many examples of it will be found in .45/70 cartridges of Frankford manufacture. Frankford Arsenal records show a number of different primers including the Martin, Benét, Hotchkiss, and the Laidley. That with pocket or hole in the center of the case in which a separate primer body was seated was known as "outside centerfire, metallic," and included such types as Berdan, Boxer, Hobbs (UMC), and Frankford ball-type anvil. The Martin cartridge, so Ordnance records show, was a service issue only from 1866 to 1868 when the change was made to the Benét cup anvil. The Martin was made up to December 1871, however, but records indicate that from 1868 on it was only made for the Navy carbine, Colt's revolvers and Remington pistol.

The real forward step in cartridge-case progress was the brass case with an external pocket and inserted primer contained in a copper cup. These cases were first manufactured exactly the same as a rimfire case, except that the rim was NOT hollow, the fold of the rim being swaged tightly together. Thus was born what is known today as the folded-head cartridge case. All early ammunition was made in this manner, and can be traced to the 1870 Martin patent. In the recent edition of a handloading handbook brought out by one of our oldest firms, a cartridge-case cross section is illustrated but misnamed "folded head." The type illustrated is actually the "semi-balloon primer pocket" described later. During a recent visit at a large American ammunition plant, I met a ballistic engineer who insisted that this was "correct," basing his verdict on the designation of the cartridge case. Yet even *he* is in error on this score.

The folded-head type was the original brass type with the inserted primer and was universally used in the seventies and eighties. Then came the improved method of solid-drawing the cases, so that a cross-section of the rim would show that the brass was unbroken by seams. It was, of course, much stronger than the folded-head type of construction, and rapidly replaced the old form in all calibers. Union Metallic Cartridge Company, however, was the first to "brag" about this type of construction. Early ammunition made by this firm bears the mystic letters "S H" on the head, along with the brand and caliber markings. This Solid Head identification was used on all ammunition as the older types of folded head shells were replaced with modern construction, until the entire UMC line was of the solid-head type. At that time solid heads had become universal and the designation was dropped from the head markings.

Government experiments kept pace with those of commercial firms. Early ammunition of Government manufacture was unmarked with dates or manufacturing designations, but in the author's collection is a Frankford Arsenal .45/70 inside centerfire bearing the markings "F-3-81-R," indicating that it was made in March 1881 for use in the *rifle*. Some of the carbine ammunition, in lighter loadings, was marked "C" instead of "R." Also in this collection is a Frankford Arsenal .45/70/500 central fire modern type of primer, folded head cartridge made in May 1884 and marked similarly for rifle use; but this case is of *heavily* copper-plated brass. Careful research fails to disclose any practical reason for this plating. The author has added several specimens similar to this since the above was written, and head markings indicate that this practice was in force for more than three years.

The period of 1867 to 1874 was one of very active development in the United States, both in breechloading arms and centerfire ammunition. Thus there is considerable confusion in the placing of exact dates and names. A vivid illustration is that of the development at Frankford Arsenal of the anvil case known erroneously as the "Berdan" case. This case was designed and manufactured and a patent applied for *before Colonel Berdan ever saw it;* according to records at Frankford, in fact, he first saw it during a visit to the arsenal.



Types of primer pockets. Left to right: Foreign primer pocket of Berdan type of construction with single center flash hole. Note the V-groove filed in the top of the anvil to permit the flash to enter the powder charge. This type is reloadable with American Berdan primers of proper size, as it may be decapped with conventional tools. Center. Modern type of Berdan primer as used in foreign cartridges. Note anvil primer pocket with twin flash holes. Must be decapped from the outside by means of a special decapping hook. Right: Modern American primer pocket with center flash holes to use anvil-contained primer

To attempt to list all developments would be impossible, as the arsenal built a great many forms experimentally which in some cases failed to be satisfactory or were used only until an improvement could be made. Thus the author recently found a .45/70 Frankford Arsenal case of folded-head construction drawn of very thin brass. The primer pocket had been punched into the brass head with the Berdan type of anvil. To strengthen this, a cup of stiff brass about ¼ inch tall had been pressed into the head of the cartridge, thus reinforcing both head and rim, and curiously enough the crimping of this reinforcement was from the *inside* rather than from the outside.

All the early types of cartridge cases contained what is today known as a "semi-balloon primer pocket." This pocket is formed by punching the center of the cartridge head into a hollow-end mandrel inserted into the mouth of the case. This type of construction, although "old," is frequently found today and must be taken into consideration by reloaders. Most revolver cartridge cases, except

the latest forms of .38 Special, use this semi-balloon pocket. One thing is very important: this semi-balloon head should not be indiscriminately mixed with the latest "solid-head" types, as there is a marked difference in loading density and a consequent effect on ballistics.

A few years ago the writer held a lengthy dispute with a fellow handloader on this subject, and decided to run the facts to earth. The .38 Special caliber was chosen, primarily because the semi-balloon head is rarely met in modern metallic rifle cartridge cases—even in the .30/30 class. Tests were run, using two makes of commercial non-corrosive primers of the non-mercuric variety. Primer size in both cases was .175. One primer was found to be more efficient than the other, and accordingly, since this volume is not intended to boost the product of an individual maker, the results of the test will be indicated by "A" and "B" to identify the two makers. In order to produce uniform comparative results, standard factory swaged 158-grain bullets made by "A" were used in every case, and a carefully weighed 5.0-grain charge of Du Pont Pistol #5. The identical seating depth of bullet was used in all tests to produce the uniformity required in that respect. Here are the results:

Components Shell	Components Primer	Instrumental Vel. Over 50 ft. Range Mean	Pressure in lbs. sq. in. Mean
A	A	891 f.s.	14,500
B	A	922 f.s.	16,000
B	B	959 f.s.	18,800
A	B	935 f.s.	16,100

An analysis of the above table brings out many interesting features which previously had been only guesswork. The last pair and the first pair should be taken together. Shell "A" had a semi-balloon head, thus greater air space than the modern solid head of Shell "B." With primer "A" there was a difference of 31 f.s. average and 1500 pounds pressure. While the latter is not important, the velocity is. These two makes and types of shells tossed together in the same box, and indiscriminately loaded by a careless shooter, would produce very poor accuracy, as the lower-velocity load will string the shots up and down the target. When this is considered in terms of score rather than group size, it might change a perfect hold which could be scored a "ten" into a low "seven" or possibly a "six." The width of the dividing rings is very thin, and the scorekeeper is merciless. This variation with Primer "A."

Now to verify this information with the same two types of shells and Primer "B." This make is stronger and gives a higher velocity and pressure. Velocity difference, 24 f.s. Pressure difference, 2700 pounds. We couldn't expect identical results, but the difference is slight—a matter of 7 f.s. In both cases the solid-head shell gives a higher velocity and pressure than the semi-balloon type head. *Facts are facts!*

When Wallace Coxe of Du Pont Burnside Laboratory ran these tests for me in early October 1933, he commented:

"The 'B' shells have a smaller capacity than the 'A' shells, which accounts, in part, for this difference, since the capacity has a direct influence on the loading density. . . . It is well to mention that neither 'A' nor 'B' primers fitted perfectly in the other make of shell. . . . It is true, as you say, 'Shooters mix cases and always will.' Such a practice is not conducive of the best results, and we strongly urge shooters to be sure to use a matching make of case and primers. . . ."

All modern rifle cases today have the "solid" type of head construction, although all revolver cases since the turn of the century have actually been of the "solid-head semi-balloon" type. Perhaps this latter type should be called "solid-rim." All commercial ammunition makers have used the solid in preference to folded-rim types since the late eighties, early or middle nineties. A collection cartridge in the possession of the writer is a .45/70/500 Frankford Arsenal cartridge loaded in 1893—and it has a folded rim. No Krag shells, we believe, were made with folded head. Even at the time the above-mentioned ballistic test was run, both "A" and "B" were making the modern solid head and had actually abandoned the semi-balloon head in this caliber, at least.

Today, in the .38 Special, all shells are solid-head, and it is but a question of time before all calibers will be made this way. Without a doubt they are stronger and safer. They cost but slightly more to manufacture and take very little more brass. They have naturally thicker side walls around the head of the cartridge where the extra strength is badly needed, and in firing they thus do not stick in chambers to such a marked degree The early folded-head cartridges, even when fired with their original black-powder low-pressure loads in revolvers, upset badly at the base, the case flowing into the extractor cut of the cylinder, badly weakening the brass. This can be noticed today if a shooter will try some .22 long rifle cartridges in *any* revolver, be it a precision Colt or Smith & Wesson, or a cheap "U. S. Bulldog." Since .22 cases are discarded as useless, this does not matter, but to a reloader, expansion at the base is a danger

sign which causes the rejection of many an otherwise "good" cartridge case.

Old-time handloaders will also recall that these semi-balloon type cases gave trouble through the breaking off of the projecting primer pocket during firing. This was frequently caused through the use of mercuric primers, but occurred in cases which had never been introduced to mercuric types. The answer probably is that these early cases were made of poor brass; the primer corroded the pocket; powders reacted on the brass; or the case simply weakened under the strain of firing. Pressure apparently had little to do with it, as many examples have been reported when reloading normal black or bulk smokeless handgun loads or in very low-pressure rifle cartridges. It rarely occurs with cases drawn in recent years.

How are cartridge cases made? This question is simple for many persons to answer, yet it is surprising how many questions along these lines are asked of firearms writers every year. Since cartridge-case manufacture is essentially the same in all ammunition plants, it can be briefly described here to good advantage.

Cartridge cases begin life very simply as sheet brass, from 3/32 inch thick up to ¼ inch in the largest shells. This brass isn't "just brass," it is manufactured for the ammunition makers to their very definite specifications—a different formula for various sizes and classes of cartridge cases. The brass is received in large sheets about three feet wide and six to ten feet long. These sheets are fed into a punch press fitted with multiple punches which knock out slugs varying from the size of a dime up to 2⅛ inches for the .50-caliber machine gun. Instead of punching these out in the form of flat slugs, the press feeds them into a die and draws the brass discs into a cup form. This press is so arranged that the slugs are punched out of the brass sheet in "staggered" fashion, so that a minimum of metal is wasted. The sheets, after they leave the punch press, are so much well-ventilated scrap; little salvage is left, and no attempt is made to rework the scrap. It is sold in bulk or carload lots to junk dealers at junk-brass prices.

During the war, all scrap was *reworked,* which accounts, in a small way, for the very poor condition of wartime cartridge cases. Specifications of the War Department dated 1918 listed the following formula for brass intended for the .30/06 cartridge: copper, 68% to 71%; zinc, 29% to 32%; iron, maximum, .05%; lead, maximum, .07%. Not more than a trace of any other impurity. This formula is typical of today's cartridge-case brass.

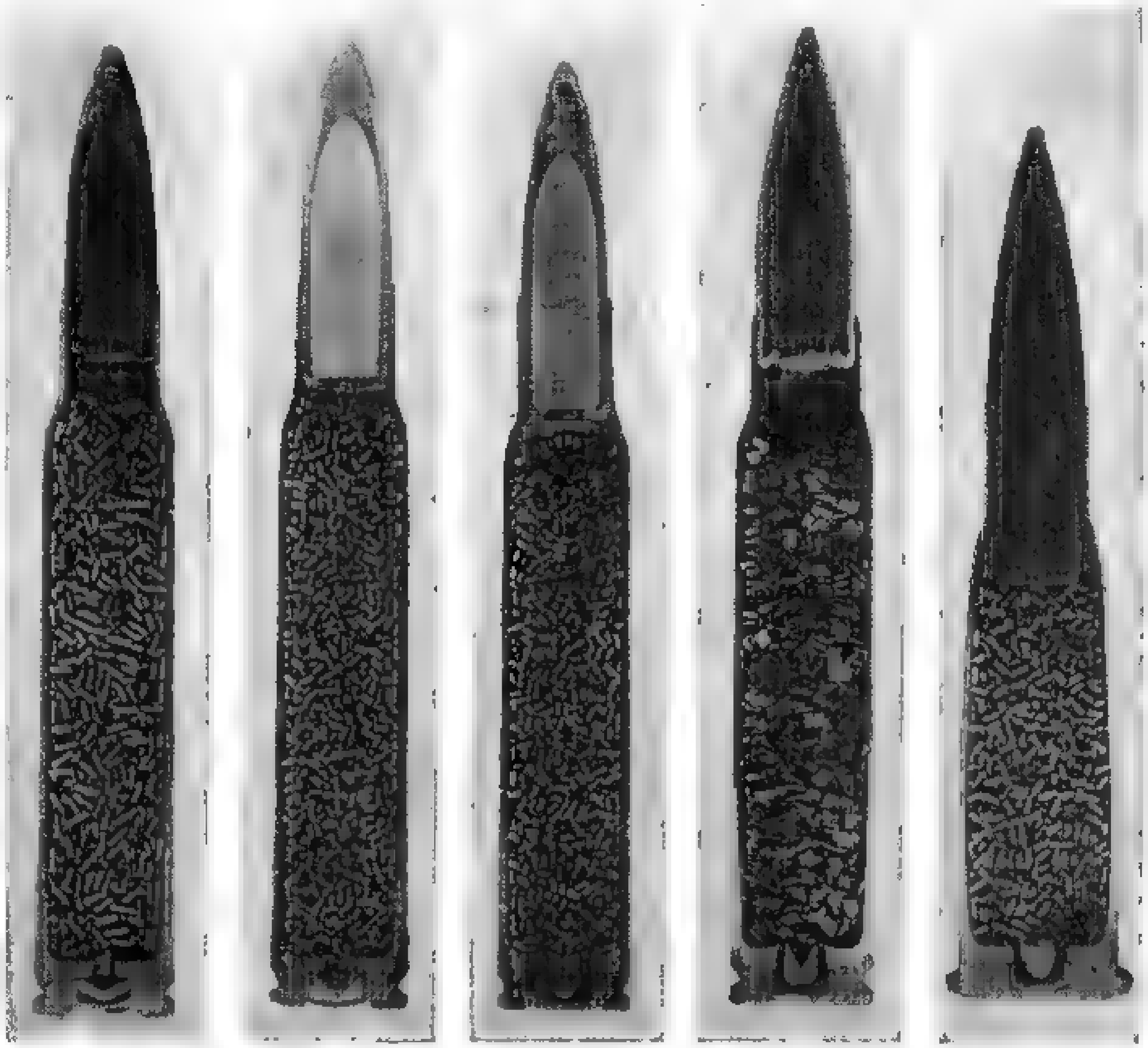
Brass, unlike some metals, "works hard"; that is to say, it becomes brittle when "worked" or punched. Usually, between the various drawings necessary to pull that blank or cup into the shape of a finished cartridge case, there are many annealings of the brass; otherwise it would become so brittle that it would crystallize and break or turn into a case much too weak for service. The number of annealings varies, of course, with the cartridge case being formed, as does the number of drawings necessary to form the case. One might assume, however, that it is usually the rule to anneal or soften the brass after each drawing.

"Drawing" a brass case is a mystic word to the uninitiated, yet it is very simple. The original cup of a cartridge case is naturally larger than the finished case body—witness the size of the blank punching of the .50-caliber machine-gun cartridge case previously mentioned. This hole punched in ⅛-inch brass 2⅛ inches in diameter is formed in that first step, into a round bottom cup 1¼ inches in diameter and about ⅞ inch high. The .30/06 cartridge case is formed from 5/64-inch sheet brass, disc 1½ inches in diameter, being formed into a cup ¾ inch in diameter by 7/16 inch high. These cups, after annealing by heating in a gas furnace to the required temperature and being suddenly cooled by quenching in soapy water, are then fed into a machine with a slightly smaller die and the same size of punch or plunger. They are thus forced through this die, causing the cup to lengthen or "draw" out to about 21/32 inch in diameter by 15/16 inch long. For its third drawing it is forced into a 39/64 die and drawn to about 1¼ inches long. These "abouts" on length are due to ragged and uneven edges of the drawings.

The next step is to force this drawing into a 35/64 die and punch it to the bottom, thus lengthening it to about 1½ inches. It is then forced into a die measuring about 31/64—a few thousandths less than the finished diameter of the case—and drawn to a length of 2½ inches. A couple more drawings and it is ready for the working process of shaping up the case. First, this round bottom of the drawing is bumped flat, or nearly so. It is then trimmed to a length of 2⁹⁄₁₆ inches and is fed to another machine which "bumps" in the primer pocket, a crude indication of what is to come. At Frankford Arsenal this case is then held tightly in a die and the head hammered perfectly flat, the primer pocket being finally formed in this operation; the letters "F A" and the year of manufacture are stamped into the head at this time. Also a faint bevel or "semi-rim" is bumped in, said rim being a temporary affair intended to aid the manu-

facturing by holding the shell easier in dies for future operations. Commercial makers form an ordinary or oversize rim, even for "rimless" cases. The primer pocket is completely formed at this operation, but the flash hole is not punched through.

Next the shell is fed into automatic lathes which speedily turn in the "rimless head" or extractor groove. In the case of rimmed cartridges like the .30/40 and .30/30, this operation is done with a different shape of cutter which removes the surplus diameter of the rim and trues it up with a slight undercut at the forward end. Since the perfection of the rim on a rimmed cartridge case controls the headspace, this operation must be carefully held to minimum tolerances. The case is then annealed half-way down from the neck, and the necessary taper formed, whereupon it is bottle-necked or formed to shape. This gives us a cartridge case with a long neck and an over-all length of 2⅝₁₆ inches. The case is then trimmed by automatic machinery to its finished length of slightly under 2½ inches, the neck is annealed, and the case is ready for the priming machines. In other words, it is finished.



Microphotos by E. M. Chamot

Cross-section of the standard cartridges now available. Left to right: (1) Standard .30/06 wartime load with 150-grain full metal-jacket bullet loaded with Pyro DG Powder. (2) Early attempt of the Army to develop an armor-piercing bullet. The soft-point load was designed for smashing out to give the solid steel core a better chance to penetrate. It was outlawed early in the game. (3) Conventional type of Springfield armor-piercing bullets loaded into standard full metal-jacket type of construction. Note that in this sample the core does not quite fill the jacket; also the armor-piercing steel core is set slightly off side. Note also Berdan type of primer construction with twin flash holes. (4) German 7.9-mm. cartridge. Note German type of primer construction, flat cup, flat top anvil of Berdan type of construction, and flash holes angle to converge the flame well into the powder charge. (5) 8-mm. Lebel French cartridge loaded by Western Cartridge Company for France during the World War. This particular cartridge was loaded to French specifications with a Berdan type of primer of somewhat different construction. Notice double cup of primer. Also notice solid bronze boat-tail bullet. This cartridge is widely reloaded today

At some factories this finished cartridge case has

had the flash hole in the primer pocket previously inserted; in others the practice in use at Frankford Arsenal for many years is still used. The flash-hole perforating is done on the priming machine. Here the shells are fed into a complicated machine, and in this respect many kinds of priming machines are used. The primers are automatically fed into a carrier. The shells feed under a plunger which dives through the bottom of the pocket to form the flash hole. At the next test point, a needle finger on the machine runs into this pocket and through the flash hole. It is an automatic tester, and if a case accidentally gets by without having its flash hole perforated, this needle is prevented from going through into the powder cavity—and automatically stops the machine until an operator has cleared the defective cartridge case. The case continues to a section of this machine which inserts the primer, while still another portion of the same instrument crimps the primer into place. The shells leaving this machine are fully resized empty primed shells, ready for the loading department.

It will be seen, therefore, that the manufacture of that piece of shiny brass thrown away so nonchalantly by the non-reloader, is actually an expensive piece of precision equipment. It undergoes numerous inspections between the various steps of manufacture, and keen-eyed girls are always ready to pull out and discard any case which is in the slightest defective. The final case must be of a very definite predetermined hardness, and the chemists and metallurgists keep an accurate check on all batches, going through the complicated but necessary physical and chemical tests of samples several times a day. It costs as much to inspect and *test* cartridge cases as it does to *manufacture* them, a little-known fact. And when you stop to think that if a .30/06 cartridge case lets go when the trigger is pulled, some 50,000 pounds of hot gas is loosed into the shooter's face, inspection and testing are worth every cent they cost. American inspection tests are more detailed and exacting than those required in foreign countries—which accounts to no small degree for the superior performance of American ammunition.

Factory manufacture of the .30/06 cartridge at Peters as checked in 1927 by the author with the aid of H. W. Starkweather, General Superintendent of the Kings Mills (Ohio) plant, indicated that there were four draws and a cupping operation necessary in production of the commercial cartridge case. Before every draw there is an annealing operation; thus five anneals plus one for reducing or body forming and a finish (tip) anneal to the neck after the necking and trimming had been completed. The cartridge case is inspected at each operation and samples are carefully examined as they come from the machines. Finished cases have to undergo a very rigid inspection.

These operations are essentially the same in all modern factories, and more or less identical for various calibers and types of shells. Rimmed cases are made exactly the same as the rimless, and at one stage "rimless" cases have a very definite form of rim on them. In the author's collection are samples of the .30/06 case picked from the production lines at Remington, which might almost pass for a .30/40 Krag cartridge, having a definitely formed rim.

There are four distinct types of cartridge cases to be met with by handloaders. Briefly summarized, they consist of rimmed, rimless, semi-rimmed and belted. The rimmed variety contains all types of cartridges from the revolver through the sporting rifle series in the .30/30 class up to old-style military cartridges now quite popular for hunting and target, such as the Krag. A rimmed cartridge case has an external rim around the head which prevents its entering the chamber beyond a certain point. From the standpoint of handloading uniformity of headspace, the rimmed cartridge is superior to all others. The rimless types have an extractor groove cut around the head of the cartridge and are popular for automatic pistols and military rifle calibers.

Proponents of the rimless cartridge have pointed out that for military purposes it permits of clip loading and therefore it is most desirable. However, the British Mark VII and its predecessor the Mark VI (both alike except for bullet design and weight) are rimmed cartridges, and since the turn of the century they have been used in clip loading. Several foreign cartridges of military distinction are of the rimmed variety. The Austrian 8 mm. Mannlicher is a rimmed case but is clip loaded. So is the 7.62 mm. Russian, the 8 mm. Lebel of France, and one of the 6.5 mm. Mannlicher cartridges used by two or three different nations. Therefore, the claim that the rimless cartridge is desirable "because of its clip-loading features" does not carry a great deal of weight.

There is one bad fault of the rimmed cartridge, however, which is not in evidence with the later or rimless type—the possibility of jamming in the magazine. The wartime Ross handling the .303 British rifle cartridge was an ugly offender. Unless extreme care was taken in the loading of the magazine, the rim of the top cartridge would project over and behind the rim of the cartridge

directly beneath it. The effect was that when the bolt face started to propel the top cartridge in the magazine from its storage position into the chamber, the overlapping rim dragged a second cartridge along with it. Net result: a beautiful jam. The writer has experienced this fault many times, particularly when clip-loading the gun, and in the several thousand shots he fired with Ross rifles after the war, when the gun was available at $5 and ammunition cost only $5 per case, he soon learned that it was almost vitally necessary to handload the magazine with individual cartridges, taking care to prevent overlapping of rims.

The third type is the semi-rim. In the military rifle series, the only semi-rimmed cartridge that I know of is the 6.5 mm. Japanese. A semi-rim looks very similar to a rimless type having the same extractor groove. The idea is by no means new, as an obsolete cartridge in my collection for the .50/115 Bullard reveals that the semi-rim cartridge was in use some forty-odd years ago.

The test of a semi-rimmed cartridge is simple. One merely lays a cartridge or the empty shell on a flat surface and holds it up to the light. If it is rimless, the straight sides or tapering body will be absolutely flat, but if of the semi-rim variety the light escaping beneath the sides of the cartridge case will clearly indicate that the rim is somewhat larger than the case body. It is a well-known fact that the .45 ACP is a rimless cartridge, as is the 7.65 and 9 mm. Luger and .380 ACP. The .25, .32 and .38 ACP are of semi-rimmed construction. In the current American rifle family there are few semi-rimmed cartridges, although in many of the regular rimmed types, in which the head of the cartridge is lathe-trimmed, certain batches of shells will show a somewhat deeper cutting effect than others and thus give the impression of being "semi-rimmed." A batch of .38 Specials recently purchased have an extremely deep groove caused by this head-trimming operation and look very similar to semi-rimmed cartridges.

The fourth type met with by the handloader is the belted cartridge case. Originating in England through the development of certain high-power sporting rifle cartridges by Westley Richards, this belted case in recent years has started to make a great impression upon the American handloader. Strictly speaking, it is of the rimless variety; but the head of the cartridge case is at least two hundredths of an inch larger than would otherwise be required if straight rimless varieties were used. The body of the cartridge case is step-cut or shouldered about an eighth of an inch in front of the extractor groove. The belted case, therefore, enters a counterbored chamber and the "belt" around the head of the case strikes the shoulder or forward face of the counterbore, thus seating solidly in the chamber. Headspace with this type of cartridge case is measured *from the face of the bolt to the forward face of this counterbore.*

A belted case, therefore, gives all the desirable features of the rimmed case plus all those of the rimless type. It does, however, necessitate a somewhat larger bolt face, and accordingly many existing actions cannot readily be adapted to handle these cartridges. For some years the Western Cartridge Company has been making the .275, .300 and .375 H. & H. Magnum Cartridge and supplying them both loaded and in the form of components to American shooters. In January 1937 a revised version of the Winchester 54 rifle known as the "Model 70" appeared on the market chambered for the H. & H. belted series.

The author's first knowledge of this gun dates back to 1933 when the Winchester factory began seriously to consider the demand created by American sportsmen for a truly de luxe bolt-action rifle. "De luxe" grades previous to this had merely meant fancy stocks and engraving, but the Winchester 54 rifle came into being purely because American sportsmen had become familiar with the excellent Springfield action and many thousands of them had rebuilt military arms into sporting rifles, including countless alterations created at considerable expense in the form of hinged floor plates, altered safeties, sleeve sights, and what-not.

The new Winchester Model 70 rifle was the answer to this demand. It features a special thumb-operated safety superior to anything we have yet seen, a revised mechanism in which the bolt stop is a separate unit and not combined with the sear as in the Model 54, a hinged floor plate and numerous minor refinements, particularly a magnum action capable of taking the H. & H. series of cartridges. The American sportsman and handloader will undoubtedly take more and more to these belted cartridge cases.

Many cartridges cannot be "magnumized" because of thousands of outstanding rifles to handle these calibers which will not stand excessive pressures. The demand, however, is for greater power in *all* cartridges and the answer to this demand will be the development of new items.

The weakest part of the modern American rifle today is the cartridge case. Brass is used for the very simple reason that it is inexpensive and easy to draw and swage to form. The cartridge case of the future will be entirely different; even though it be made of brass, the formula, heat treatment

and method of manufacture will be much different from that in use in 1937. Steel cartridge cases may come in. They are not new. Toward the end of the World War, the Germans experi-

Mauser steel cases, removed the Berdan primer, and by means of some delicate work on the cartridge case, rebuilt it by removing the Berdan type of primer anvil and building the pocket to handle

Manufacturing cartridge cases at the Kings Mills Ohio Plant of the Peters Cartridge Company. General view in the metallic department

mented with materials for cartridge cases, and because of the shortage of brass turned to steel and drew many successful cases which they copper-plated to prevent rust. These steel cases are very plentiful in the United States in the form of souvenirs brought back to this country by returning soldiers. Some ten years ago one of the author's co-experimenters acquired a batch of 8-mm.

standard American types of primers. These he used with full-charge loads for many reloads without suffering splits or other case defects which would cause rejection. They were, however, extremely difficult to resize, and he discarded them after a dozen or more reloads. Frankford Arsenal, too, during and following the War, experimented with steel cartridge cases, bearing in mind that in

time of war a brass shortage might create complications.

There are a number of materials which undoubtedly would make a much stronger cartridge case than the present types of brass. Cartridges will some day be working at super velocities and pressures in the 100,000-pound class. It has been clearly demonstrated through elaborate experiments that the standard-issue Service Springfield can be depended upon to handle pressures far in excess of 100,000 pounds—*if the cartridge case does not let go!* Various types of bronze cases might be the answer. Aluminum in its raw state is actually useless, but alloyed with other materials is as strong as steel and exceedingly tough. It has for many years been used in girder consruction, in lighter-than-air craft, and in many other places where extreme strength together with light weight is desirable. Thus in the form of one of the modifications of duralumin may be found the ideal cartridge-case material.

Too, there may be a practical development in the form of beryllium copper. This recent development is still a bit too expensive for use in cartridge cases. It looks like copper but is extremely strong and tough. Harrington & Richardson discovered its practical qualities many years ago when they brought out their .22 Single Action Sportsman revolver and manufactured firing pins of this material. It was the first time a firing pin had been manufactured of a copper alloy. The author has seen numerous revolvers of this make which have been shot from 30,000 to 50,000 times, meaning at least as many hammer blows on the small and delicate firing pin of this gun. In no case did the beryllium copper pin appear to be mutilated. A soft steel pin under the same conditions would have been upset badly through hammer contact. A hardened steel pin will very frequently crystallize and break. Beryllium copper, therefore, if it is possible to produce it at a sufficiently low price, might point the way toward a new series of cartridges many times more powerful than those in use at present.

Ammunition makers during the past few years have learned much about cartridge cases and are loath to give up brass. They are developing greater strength than previously known and are inclined very favorably toward the "magnumizing" of many of the present rifle and revolver cartridges. Predictions along this score would be futile. The handloader will see for himself.

IV

CASE INSPECTION AND PREPARATION

EXCELLENT though the factory inspection tests are, they can be elaborated upon by the careful handloader. In this game one should never assume that all cartridge cases are alike or that they are in perfect condition. Only careful inspection can verify this, and the inspection should be performed *each time the case is reloaded*. Precision handloading calls for something more than carefully weighed powder charges; it requires proper sorting of cases into matched groups, and once sorted, these cases should never be mixed indiscriminately. The drawing process very frequently thins the neck of the case more on one side than the other—such cases should never be used for the finest of target or long-range varmint loads. Thin case necks throw the bullet off-center, thus starting it into the barrel improperly. Thin cases also are inclined to start a bullet tipping, since the bullet lets go on the thin side before it releases on the thick portions, because of the lesser elasticity of the brass.

Only by careful visual inspection can the thin case necks be detected. A magnifying glass, even of the cheapest of "reading glass" types, is useful for this. For the greatest of ease in handling, the handle of the glass should be attached to an upright, thus permitting plenty of room underneath for the use of the hands. This set-up is useful in examining all types of cases. In use, the operator picks his case up normally, holds it beneath the glass, and slowly rotates it, raising or lowering it to bring the part of the case to be examined into proper focus. Case necks should always be true, and necks that are thin after firing, are inclined to draw out more on one side than the other, thus giving an imperfect neck length. Examination under a glass will bring out these defects with greater ease, eliminate eye strain, and speed up the inspection.

There are a number of good glasses on the market, all suitable for magnifying purposes, and obtainable at almost any price the handloader desires to pay. Naturally, the better the glass, the more expensive it will be, but the best of glasses are quite reasonably priced. Bausch & Lomb reading glasses can be obtained for two dollars up, depending on size. There are many German glasses on the market which can be purchased for seventy-five cents up.

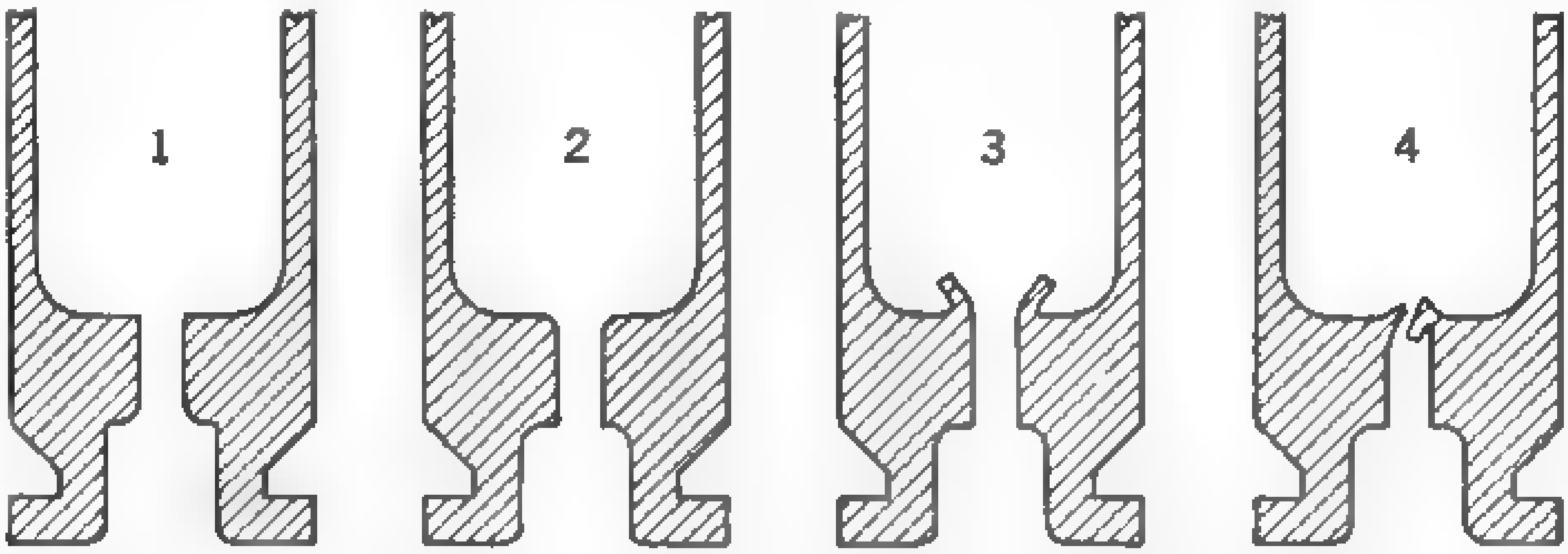
The ideal glass, of course, would be a corrected magnifier. By this I mean that it should be optically correct through a multiple-lens system, so that the field of vision is entirely flat and free from distortion. A glass of this type naturally costs much more than one with the so-called "single-lens" system, but it is well worth the initial investment and will speed up the work of the inspection to a remarkable degree. A very excellent glass for the purpose is what is known commercially as a "fingerprint magnifier," designed primarily for the use of fingerprint experts in examining either photographed or latent prints. This glass has recently been adopted by stamp collectors for examination of specimens.

This glass is available in a standard horseshoe-type base or stand, thus eliminating the necessity for holding it in the fingers. At the same time it can be obtained in various special stands costing more money. It is not necessary for the intelligent handloader to purchase one of these stands, as he can buy the ordinary glass and make some sort of support to meet his own requirements. The important thing is to secure a truly good glass. When an attempt is made to get a glass of this grade, the purchaser would do well to obtain either the Spencer or the Bausch & Lomb. In the Bausch & Lomb type of construction this glass is known as the "Utility Magnifier," catalog number 229. The lenses are 35 mm. in diameter (about 1⅜ inches), and magnification is 4½ ×. It is an excellent instrument for examining cracks, defects and primers, since it does not distort the field of view in the slightest.

A third type of glass used by many handloaders is the so-called "folding pocket magnifier" used by police officers and scientists who desire magnification in an extremely portable form. These are available in single pocket lenses, also double and triple types in which three simple lenses are put together. Their cost is extremely low. The single lenses of Bausch & Lomb sell from about 90 cents to $1.50 and have a magnification of from 3 to 5×. The double and triple lenses run up to about $2.50.

The best form of these portable magnifiers of

pocket variety is, of course, the so-called "Doublet" and "Coddington" magnifiers as well as the Triple Aplanatic and Hastings. These use a small barrel type lens holder with double or triple lenses, the assembly folding into a little metal case or lens protector. Magnifications of 7, 7½, 10, 14 and 20× can be obtained, but they are not truly practical for inspection work, since the power is too great to be useful and the field of vision so small that it greatly slows up inspection. They are ideal, however, for examining the detail of primer pockets, flaws, etc., and a 10× or 14× magnifier of Triple Aplanatic lens construction is a useful addition to any handloader's kit. The Utility or fingerprint magnifiers or the simple reading glasses are of much greater assistance, as they can be mounted to allow the use of both hands beneath them for holding and rotating the shells during inspection. A large field greatly speeds up the work and eliminates the inclination to overlook this important but bothersome ritual of handloading.



Primer flash hole punching: (1) Flash hole punched from the inside. Notice how it tears away the bottom of the primer pocket. Although used in some makes and calibers, this is falling into the discard. (2) Flash hole punched from outside. Surplus metal torn away from inside of case (3) Pocket punched from outside. One frequently finds that instead of tearing away the metal it is rolled up in the form of a burr inside the case. (4) If the case is primed on a plunger similar to that of the Bond Model "C" type of loading tool supported on the inside, the burr is very frequently folded into the flash hole, partially or fully closing this. Net result: faulty ignition, misfires, hangfires, and blown primers

Case necks should be carefully examined for cracks after each firing. It is much better to do this work immediately after firing—within a few days—than to delay it until the next time the shells are used. Wipe off the usual smoky stains from the neck either with a cloth or by rotating the shells in the fingers. Examine the shell by rotating under the magnifying glass, searching both the outside of the mouth and the inside for cracks of the season or pressure variety. A season crack is usually a simple split caused by the failure of the brass case neck to hold a bullet which has been seated in it, friction-tight, for a long period of time. Season cracks are due to anneal, faulty brass, or brass which has died of old age. They are often known as fatigue cracks and mean exactly that. The metal, under strain, has just naturally let go

The inside of the mouth of a cartridge case can readily be examined by holding the shell under the glass so that one can look at it while light is entering it, and such examination will often disclose certain seams and scratches which may develop into cracks. It will also reveal uneven chamfering of the case mouth. This sounds like double inspection. It isn't. The shell is slowly rotated in the fingers, and after covering the outside of the neck with the eye, the shell is tipped slightly and the rotating is continued. DON'T TRY TO HURRY! Inspection, to be of any value, must be thorough. Do the job right, or don't waste any time on it.

On bottle-neck shells the inspection should be continued so as to cover the shoulder of the case where it starts to "neck down." This is important. On rimless shells, this point controls the headspace, and care must be taken to see that the shell is not damaged here. Many shells will be found with faint cracks at this point, and these, of course, should be discarded promptly. While minor gas leakage through cracked or "punctured" shells is not necessarily dangerous, it may be serious. It is certain to damage the chamber through erosion or burning out of the metal. This causes a rough chamber, sticking cases, and opens the path for rust and a multitude of extraction sins. Furthermore, any damage of the chamber at the shoulder is inclined to alter headspace, and the only recourse is to return the barrel to the factory for a complete tear-down, turning-off of the barrel, and rechambering. All of this costs money.

Case Resizing. Should cases be full-length resized? Here is a question of extreme importance, and one open to much argument. For target use, cases need not and should not be full-length re-

sized. For hunting, however, a full-resized case is desirable because it makes an easier chambering shell—a fact due to its close approximation to factory dimensions. This case of handling is almost necessary for the best of speed firing. For small-game hunting, particularly for such game as varmints at reasonable and long ranges, best results are obtained from precision loads prepared in accordance with the finest of target standards, and here the cases had best be only neck-sized. Full-length sizing for handgun loads is highly desirable, since cases of this nature are generally of the straight cylindrical body type of construction. In most .38 Special cartridges, factory cases measure .373 or .374 in diameter, while the average Smith & Wesson chamber runs about .379. Few recently manufactured Colt chambers run over .380. The full-length resizing die on the author's Star speed-loading machine sizes cases to .3765. Two Pacific dies we have in the collection size .3762 and .3765. A full-length sizing of the "hand" type of construction sizes .3770. Thus it will be seen that the average handloading die does not reduce shells as much as their original factory dimensions—instead actually halving the average between fired shells and new factory shells.

For use in assorted handguns, it is wise to resize shells full length, as this means greater interchangeability of the loaded ammunition. There is nothing more embarrassing than to take one of your pet guns out for an airing, together with a supply of handloads, only to find that the shells are a bit too tight for that particular weapon, and must be forced in with more or less strenuous effort. If the shooter should appear among other gun bugs with such a combination, his handloading efforts would be derided and criticized. Also, regardless of the standardization claims of revolver manufacturers, the handloaders occasionally find that an arm for which they desire to handload has one or two chambers slightly larger than others. Accordingly, the shells chamber a bit too tightly when removed from one chamber and inserted in another. Revolver manufacturers will deny this indictment, but the author knows this to be true of no less than three revolvers belonging to our so-called "best quality" makes. Since he has been through both plants on a number of occasions and watched the manufacture of these commercial weapons from the raw forging to the final inspection, he cannot understand how it could happen—yet it does, occasionally.

Still another reason for the resizing of handgun cases, either revolver or automatic pistol, is uneven expansion at the base. Any trained shooter can pick up an automatic pistol cartridge case and, from careful examination with the naked eye, determine its position in the barrel of the pistol at the time of firing. This is not legerdemain—it is nothing but simple observation. The bottom of an automatic pistol barrel at the mouth of the chamber is invariably chamfered slightly as an extension of the receiver throat to guide the loaded pistol cartridge in its journey from the magazine or clip into the chamber. Accordingly, when the shell is fired, the bottom of the cartridge case expands into that enlargement of the chamber mouth, thus bulging the shell slightly on that side. Unless a full-length resizing irons out this bulge, the shell is liable to stick if again inserted into the chamber in a position somewhat different from the original firing. The bulge might even be sufficient to prevent complete closing of the breech block, thus creating a malfunction of the arm. While the reloading of automatic pistol cartridges is not generally recommended by the author, the cases should in every instance be given a full-length resizing if they are to be reloaded.

In revolvers the cartridge-case heads are also inclined to swell during the firing—an effect due to the flexible action of the extractor of a modern double-action revolver. This extractor partially encircles the base of the cartridge case, supporting it during the act of firing. It is not, however, as solid as the remainder of the cylinder walls and has a certain amount of spring to it. If the case head is more than ordinarily soft, that segment contacting the extractor will expand, owing to lack of suitable resistance. All revolver shells should be inspected under glass for defects at this point, and at the first sign of them the empty shells should be rejected.

In such cartridges as the military types, full-length resizing can produce many dangers, particularly that of creating excessive headspace (see chapter on Headspace). No cartridge should be loose enough in a chamber to rattle around, and little if any movement should be noticed when it is inserted with the fingers and moved "sideways" with gentle pressure of a finger. There has been too much over-resizing of cases in the past. Each time you resize, you "work" the brass of the case, and this never helped brass to any great extent. Without a doubt, full-length resizing shortens the life of a cartridge case, and if military calibers are used, this method of sizing should be done only at infrequent intervals. The writer has had as many as three Springfields at one time, and in every case the fired shells from one gun would interchange with those of another, and could be inserted in

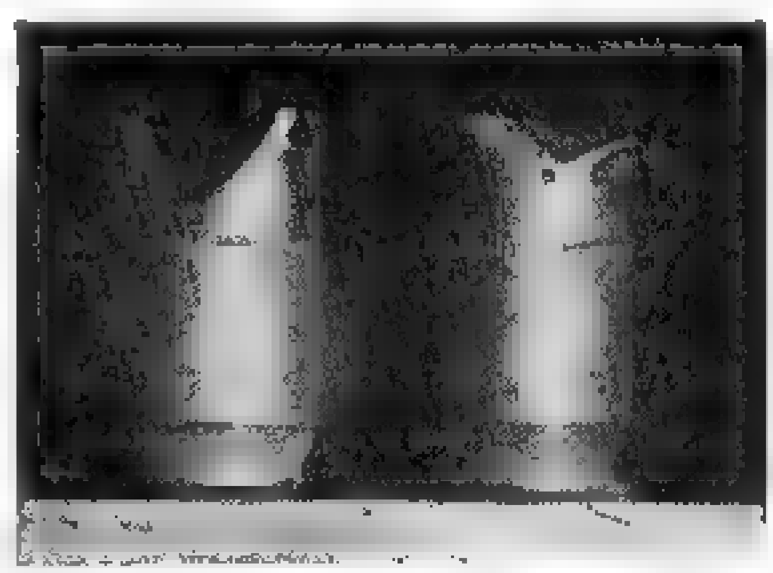
the chamber and withdrawn without effort. Here headspace plays an important part. The writer's rifles in this caliber are all set to 1.9435. We had one, however, with a "tighter chamber" which measured 1.942. Care had to be exercised to prevent cases from getting stuck in this arm, and separate cases were kept for it.

Effect of mercury on a cartridge case. Brass became extremely brittle and the loaded cartridge was broken by pressing on the bullet

I distinctly recall one incident of several years ago. A loaded mid-range cartridge with a 150-grain old-service full-metal jacket was used. In some manner one of my cases fired in the rifle with normal headspace happened to get into the tight chamber batch. The bolt could not be closed, and when we tried to extract the unfired cartridge, the extractor pulled over the rim. Whereupon we tried to close the bolt with force, that the cartridge might be discharged, thus freeing the case in the normal manner. No go! We wedged that cartridge tighter, but couldn't get that additional .0015 necessary to close. The result was suspension of firing, a crippled rifle, and some three hours of hard work when we got back to get the cartridge out of the gun without damage to the barrel. It had to be done promptly, too, since the barrel had been fouled by previous firings with corrosive primers. The upshot of it was that we sold that rifle to a friend who happened to be a "one gun" man—and he was safe in his reloading.

There is one additional resizing stunt that is well worth considering the so-called "fire fitting" method. In this the shells are fitted to the chamber of the gun by the simple process of shooting them in that gun, whereupon they expand to a useful size. From that time on they should not be full-length resized, particularly if a sturdy bolt action rifle is used. The necks, only, should be given a sizing, and then for the sole purpose of holding the bullet solidly in the case. The fire-fitting method is often used to adapt strange shells to a given gun. In this the author urges extreme CAUTION! For instance, the intelligent handloader who has an 8-mm. Austrian Mannlicher for which he desires to handload, finds that the ammunition is next to impossible to obtain, for the very simple reason that it is not commercially loaded in this country and accordingly is obtainable only with Berdan or non-reloadable types of primers.

An ideal substitute for this case is the 7.62 mm. Russian, which is obtainable commercially from our major ammunition manufacturers. True, the case is not the right size, but it is nearly so. The head of the case is slightly too thick, as the Russians use a somewhat rounded face on their cartridges. With a little bit of delicate work with a file, however, an intelligent handloader can thin this down slightly until he gets the proper thickness to permit complete closing of the Mannlicher bolt. He then loads the cartridge with a few squib loads—light loads using mid-range charges with any type of bullet. These are fired in the Mannlicher rifle and the case expands to fill the chamber. Only light loads should be used. *Never, under any conditions, should the shooter attempt to fire a full-charge Russian cartridge in the Mannlicher rifle!*



Light reloads in automatic pistols frequently cause jams, spoiling the cartridge case for future use

In fire-fitting some cases will split, but even when wartime material is used, excellent results can be obtained with a few carefully chosen pieces of brass. After a few squib loads with the case, during which it is gradually fitted to the chamber, it can be used for full-charge or normal loadings; these, however, should be inspected carefully after each firing to see if the brass is weakening because

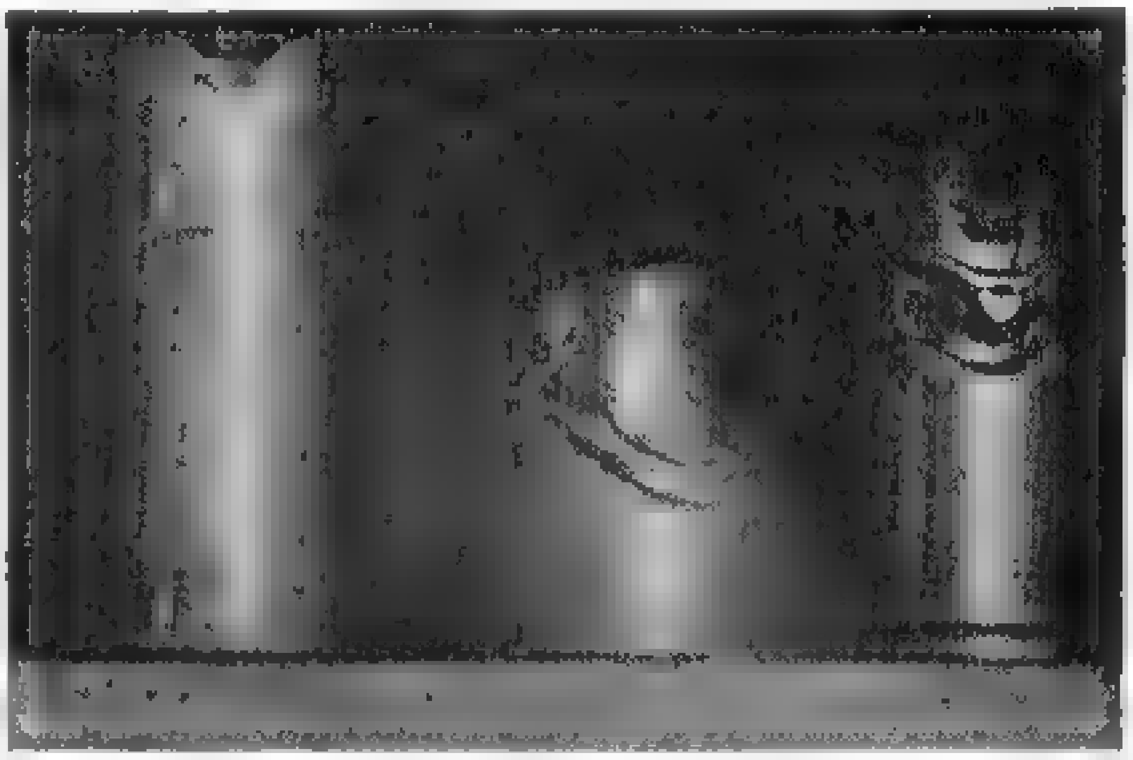
of the unusual strains imposed upon it. Let me repeat the caution. In the hands of an intelligent handloader, this trick can readily be acccomplished. It has been used for years by experimenters who endeavored to fire-fit to their guns, cartridge cases manufactured for an entirely different type of weapon. It is work, and undoubtedly a number of cases will be spoiled, but if squib loads alone are used and care taken by the handloader, neither shooter nor gun will be damaged in the slightest.

Neck Resizing. In resizing case necks, extreme care must be taken to see that the necks are in perfect alignment with the body and true with the chamber. This cannot be done if necks are thin on one side. A resized case neck, whether the neck only or the entire body has been reduced in a die, is only half completed. The neck must be expanded to just under the bullet diameter. For the .30/06, using jacketed bullets of .3085 diameter, the necks are usually expanded .307, .3075 or .308. In the same caliber, cast and gas-check bullets require a neck size of .311. This is accomplished by pushing a hardened expanded plug, ground to the proper diameter, into the case neck and withdrawing it. The process is a precision one, and can best be performed with one of the regular loading tools on the market. This process can also be classed as an inspection process if desired, as a certain amount of effort is required to force each shell into the resizing die, and another degree of effort to expand it. If an occasional shell expands too easily, it should be set aside as having a soft neck.

Some of our loading tools do not do a good job on certain cartridges. The Pacific and Belding & Mull and one or two others neck and full-length resize and expand the inside of the cartridge case, all in one operation. In some calibers this results in split necks, since the bearing surface of the die and plug are much too close together, causing an overworking of the brass. In recent years both firms have endeavored to correct this problem and have succeeded to a remarkable degree. If, however, you have a loading tool with this annoying habit, try doing the sizing and expanding as two separate and distinct operations and you will quite likely eliminate the destruction of your brass.

Do not, however, confuse this with mercuric destruction of brass. Some cases, if used with a mercuric primer, will resize perfectly, but when the expander plug is run into the neck they will promptly and emphatically split the whole length of the neck. Using a recent loading of 7-mm. cases which had been factory-loaded with a noncorrosive mercuric primer and fired once, the author found that every case, when resized the same day it had been fired, would neck down as desired, but would promptly split when the expander plug was inserted.

Oiled Cases. Some reloaders like to use oil on their cases—still others prefer powdered graphite. I use neither except in rare intervals on full-length resizing of rifle cases. My cases are never cleaned with acids and other chemicals—I merely wipe them free of dirt and let them ride. If they are wiped before resizing—with a clean cloth which may have a faint trace of oil on it—they are easier to inspect and resize, and there is less wear on your sizing dies. On the other hand I never use graphite, because, regardless of the recommendations of some loading-tool makers, this handloader has found that it badly blackens cases, actually grinding the black metal into the pores of the brass. Perhaps this will have no effect on the head pressure or back thrust of the cartridge case; but since graphite is an anti-friction metal, it *should* have about the same effect as a well-oiled cartridge inserted into a rifle. The effect on a well-lubricated cartridge case when fired in a rifle is discussed in detail in the chapter on Pressure.



Careless use of the resizing die can ruin good brass. The two cases on the right were completely crumpled with little effort by slapping them deliberately without attention to lining up in the Pacific tool. Such mutilations are rare in service. The case on the left is, however, more common, and such a case is just as useless to the reloader

Life of Cases. What is the life of the fired cartridge case? The question is one frequently asked. Frankly, I don't know; nor have I ever met anyone who would venture an opinion. Many years ago I tried to find the answer to this question through an actual test. Ten commercial cartridge cases were chosen from each make of .30/06 cartridge—Remington, Winchester, Western, Peters, and United States Cartridge Company. These cases were from batches of commercial cartridge cases purchased in 1927. The test began March 5, 1927,

with all fifty cases loaded with a standard full-charge load developing in the vicinity of 50,000 pounds pressure. No effort was made to rush the experiment, but the original primers were removed and were replaced with Winchester No. 35 NF, a non-fulminate primer almost identical in formula with the Frankford Arsenal No. 70 primer. This is a non-mercuric but corrosive type, and was used for the very simple reason that no non-corrosive primers were available at the time, while I had on hand several thousand of these Winchester primers of wartime manufacture.

Poor brass and wartime cartridge cases. The 1918 Krag cases were made by Remington. These are frequently found and should not be used if they show the slightest sign of a rupture. Left and right, a partial rupture. Center, complete head separation. Had it not been for shooting glasses, the man behind that gun would have lost his eyesight

Numerous loads were used—various powders such as IMR 15, 15½, 16, 17, 17½, 18, 20, 1147, 1185, and experimental powders which need not be mentioned. The sole requirement was that all cases should be loaded at the same time, fired at the same time and with the same load, and pressures held in the vicinity of the 50,000 mark. It was a great idea for a test, but rather fatiguing. The test isn't finished at this writing, since I did not use these cases all the time, preferring loads developing less pressure. At present they are undergoing their forty-third loading with a Remington #8½ non-mercuric non-corrosive primer, and there are forty-nine of the original shells left, not one of which shows any signs of failure or of unreasonable stretching. My notebook indicates that when the thirty-second load had been fired, it qualified them as top-notch Masons. The only lost case was due to an improper set-up of a resizing die on the fifth reload, back in 1927, which buckled a neck and caused an immediate discarding of the defective shell.

One may therefore assume that cartridge cases of modern manufacture can be used *indefinitely* with modern components and reasonable care. Not one of these cases has been full-length resized; only full charges have been used, and they were shot in the same rifle up to the twenty-fourth reload. Since they chambered perfectly in a new Springfield, they were shot in this gun after the older one was discarded. And just in case you are analytical-minded, each of those fifty cases—from our five commercial makers—has held 2200 grains of powder, or nearly a third of a pound, and therefore has withstood about 2,200,000 pounds breech pressure. The simple little life-test appears to be a long way from being finished, as we have just begun to trim off the necks of the cases owing to signs of elongation. Trying to "find out" has consumed about 15 pounds of powder worth $24.00, 2200 primers worth $7.92, and 2200 assorted bullets worth commercially about $59.40—a total cost of about $82.00. Not one of these cases looks any less serviceable than others in my supply which have been fired but two or three times. They will be used until they fail, with a record of loads kept merely for the sport of it, and to determine the life of normal shells with good primers.

Some years ago, commenting on the life of the brass in cartridge cases of the .30/06 and .30/40 caliber, Colonel W. A. Tewes, Director of the Peters Ballistic Institute, wrote me: "Their life depends on the pressures they have to withstand, the comparative amount of metal, and its retention of resiliency. They are bound to stretch with continued use, and to become annealed with continual firing so that their original properties are lost. . . . Years ago, on Government contracts, the specifications called for five shells to be reloaded twenty times for casualties as a test of the shell metal. I don't recall that we had any casualties, but the shell necks needed constant trimming to keep the necks within gauge dimensions, as they would inevitably stretch with a load like the .30/06, .30/40, etc."

The author has always found Peters shells to have a very excellent neck anneal, which prolongs life when used with non-mercuric primers. This may account for the stretching of the necks, but in the case life-tests just described, there has been no excessive stretching. Possibly a lucky choice of brass in the five makes.

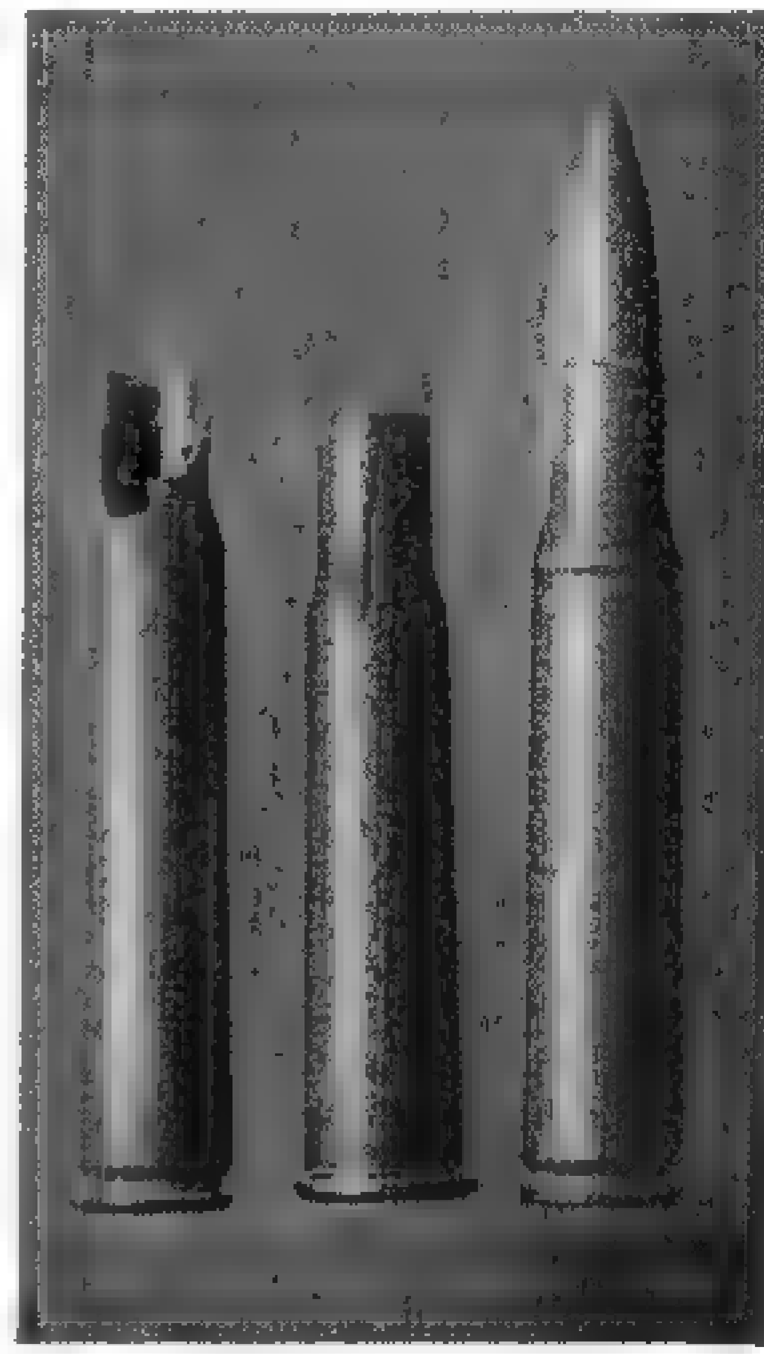
Many other cartridge cases of the same caliber have shown cracks and other defects which caused

their rejection after five or six loadings. Every effort is made to analyze these defects, but so far it has been hopeless. Some commercial brass is better than others. Some is of proper temper and proper formula. This performs best. Other cases are a bit too soft or hard, and soon develop flaws. It is safe to say, however, that a cartridge case, if used exclusively with non mercuric primers, and if it happens to be of a good quality at the start, is good for 25 to 50 loadings *at the pressure for which it was designed.* This means a lesser case life for .30/06 cases at 55,000 pounds, and a longer life at 35,000 pounds. It also means that a .38 Special will last longer at normal velocities than at the high speed or super velocities.

The above statements of case life are put to shame if one considers the famous cartridge case owned and used by that master craftsman and shooter, Harry M. Pope. Mr. Pope for many long years was an ardent and enthusiastic Schuetzen rifleman. Like other good Schuetzen men, he used a single cartridge case, loading it on the rifle range, seating the bullet into the *barrel* instead of into the case neck, and actually building a blank cartridge to propel his special target bullets. The author believes that this famous case of Mr. Pope was one of the Ideal Everlasting shells, and was, of course, more or less handmade and much heavier than the factory-drawn cases. At any rate, Pope carried this one shell for years and had a record of approximately 40,000 loadings with it. The story, however, would have been much different had it been a factory-drawn case and had the bullets been seated into the neck, thus necessitating resizing.

Another prominent rifleman today who was well acquainted with some of the old-timers of past years remarked with considerable mirth that he once heard the famous Dr. Hudson "crabbing because one of his Ideal Everlasting shells had cracked on him after some 700 loadings." The life of a cartridge case cannot be predetermined. It will vary with each lot of brass and with each type of load employed.

Some years ago the experts of the Frankford Arsenal decided to determine the life of their ordinary garden variety of .30/06 case. The idea was to equip all major ordnance depots with facilities to machine-reload fired cartridge cases using a light or gallery load. The load used for experimental work was very similar to the famous lead-bullet gallery load much in evidence in the years immediately following the World War. The FA boys selected a batch of shells at random—about 100 of them, if my memory does not mislead me—and set to work reloading and discharging and again reloading those cases. After 103 reloadings, during which they had not lost a single case, they gave up in despair, and the question, of course, remained unanswered. Summed up, cartridge cases, if made of good brass, will last indefinitely, if cared for and not over-resized or overworked by the handloader. If an occasional shell fails after a



Mercuric primers have a bad effect on cartridge-case brass. Left, three mercuric primers used in the Springfield case. Final loading was broken in the fingers after the bullet was seated. Center, Krag cartridge fired once with a mercuric primer. Right, the primer is stronger than many people think. This wartime cartridge was shot on a target range. It appeared to misfire. Examination showed that the flash hole had not been punched and the force of the primer drove the cartridge into the chamber, buckling the shell at the neck

dozen or more reloadings, this is no reason why the handloader should feel disturbed. These failures will happen and they never become serious or cause any trouble *if the handloader develops a thorough system of inspection.*

Chamfering the Case Mouth. Should case necks be chamfered? Opinions differ. The author personally prefers to chamfer all case necks, whether in revolver or rifle sizes. This does not mean that he reams a taper in those necks until they are feathered down to a knife edge—far from it. He merely cleans the edge to free it of burrs. There are various reamers on the market especially built for handloaders, and the prices vary from a lot to a lot more. The most satisfactory reamer, however,

is a standard plumbers' burring reamer, intended for use in reaming out pipe stock after cutting. The one I have is known as Union Twist Drill Co. #33, and was designed to be used in pipe having an inside diameter up to 1¼ inches. This Butterfield reamer is ground on a 28° taper and is small enough at the nose to enter the smallest case used for handloading—the .22 Hornet.

In use this reamer is held in the hands and the neck of the case dropped over it and *very gently* rotated to remove the faint trace of a burr. Too much will feather the edge, spoiling its utility for anything. Careful examination under the previously mentioned glass will clearly indicate that even the new factory cases have this trimming burr on them. I usually ream this out with a very light touch of the shell against the reamer, and gently rotating the shell. Here is one operation of handloading that should not be speeded. Too much neck chamfering shortens case life, and serves no practical purpose. It also is inclined to tip the bullet as it leaves the case to enter the rifling. Practically every cartridge case this writer has examined, shows a necessity for mouth reaming—and yet nearly every case of other reloaders we have handled either shows a lack of any case-mouth reaming, or *too much.* You don't need a funnel mouth on your shells, so why try to ream it? Chamfering needs to be done only once. If you insist on funnel mouths, these can easily be achieved by placing a rather large steel ball or ball-bearing over the mouth of the shell and tapping gently with a block of wood. This will funnel out the mouth and prevent bullet shaving in loading with cast bullets. Too much belling of this sort is inclined to split the shell mouth—and what is of more importance, will not permit the cartridge case to enter the bullet seating die. Use discretion.

Bullet Tension and Pull. Watch out for too-soft case necks. If necks are too soft, they will not hold a bullet tightly, and thus the pressure will not build up quickly. In the .30-caliber class there should be approximately 75 to 100 pounds pull necessary to separate a bullet from the neck of a cartridge case. There is no way for an amateur to measure this pull, unfortunately, but a careful inspection of his cases before, during, and after the resizing process will help to eliminate the soft brass. If an expander plug enters the mouth of the case too easily, it is a sign either that the plug is too small, the case neck is too thin, or the brass is too soft. Inspect that particular case at once. With a known size to your resizing expander, and the aid of a glass for the inspection, you can determine the trouble promptly. Here, however, too much chamfering of the case mouth will defeat your purpose as it will nullify your efforts to determine a thin or unbalanced case neck. If the neck appears to be of normal thickness, the trouble may be in too much neck anneal in which the brass has lost its resiliency. Such a case is no longer fit for service and should be rejected promptly.

Discarded Cases. How to dispose of brass cases? This question is very important. It doesn't mean that I have any suggestions as to the proper choice of junkman, but it does mean that I wish to stress the importance of eliminating once-rejected cases from those which pass inspection. Cases, once rejected, should be *destroyed immediately.* An empty pasteboard box will suffice to hold them until inspection is finished, whereupon they should be gently placed on a block of lead or steel, held in position with the fingers, and enthusiastically socked with a hammer. If the case is held by the head, one soon learns with surprising ease to connect the hammer face with the neck of the shell, thus positively identifying it as "no good." If a hammer is not handy, one can clamp down on the neck with a pair of pliers and get more or less the same result. Cases so mutilated are gone beyond repair, and what is more important, they never accidentally get mixed with good cartridge cases and thus create trouble. A case with a soft neck, for instance, may look good before the operation, but if it accidentally gets into the batch of good cases, the net result is a low shot on the target, or a miss on game with an otherwise perfectly sighted arm.

Once these cases are destroyed, throw them in your junk box. You will then never be tempted to rescue a couple which look "pretty fair" to round out a lot of ammunition on which you are running short of cartridge cases. If you reuse any rejects, your inspection will be for naught, and will be doubly difficult the next time. You may be able to remember "which was which" and reject them at the time of firing—but the average person forgets with surprising ease. Another good hint is to examine cartridge cases at the time of firing—if you have a moment to spare. If there are any cracks or other visual flaws, *throw them away at that time.* It will cut down your home inspection, and will possibly reduce the load of empty cartridge cases you bring back from the day's shooting.

Primer Pockets. Still another point worthy of periodic inspection is the primer pocket. If you reprime a cartridge case at any time and find that the new primer slips in very easily, *discard that case!* Stretched heads are not uncommon, particu-

larly when they have been used at high pressures. The author recently experimented with some high-pressure loads in a Winchester 54 rifle in 7-mm. caliber. Ten hand-selected *new* Remington cases were chosen for perfection, and experimental firing was conducted with a load developing slightly more than 65,000 pounds. This load is dangerous, we admit—some 10,000 pounds more than is safe for *any* cartridge case. After firing we found that one primer dropped out, one leaked gas, and the other eight shells decapped easily. Examination of the fired shells under a microscope showed no flaws, but the pockets had stretched so that the shells could be reprimed with a reasonable pressure of the thumb. Of course those cases were discarded.

Occasionally one finds a cartridge case that is unusually soft. The reason is this: The annealing process is done in automatic machines and furnaces of the gas-heated type. The cases are rotated in a flame for a definite time, and then quenched. For the complete annealing process, the cases are often tumbled in a perforated or wire-mesh drum contained within an oven. The heating is definitely controlled, and at the end of the annealing period the entire batch is dumped into the quenching liquid. Occasionally, although not very often, a shell sticks in the mesh and is heated a second time with the next batch. It looks the same as one properly treated, but is unusually soft. Such shells are frequently caught by inspectors and are discarded at the factory; many, however, do get by, and these soft shells, even in the large, solid-head military types, will expand on firing so that primers fit loosely. Discard them as soon as you locate such a defect.

Examination of the primer pocket under the glass *before decapping* will often locate primer leakage. This should be run to earth. Leakage is usually due to either an improperly fitting primer, a large pocket, or a soft head. Take no chances with this end of the shell. It is only a few inches away from your eye during that period when the hammer "faw down and go boom," and even a small amount of leakage can create a great deal of havoc if distributed improperly in that portion of the shooter's anatomy which makes him beautiful. Primer leakage in bolt action rifles is less serious than leakage in other types, but there is no fun in it at all.

For your most accurate loads, choose cartridge cases under the glass which have perfectly centered flash holes, and be sure that they are of uniform size. Certain authorities recommend the reaming out of flash holes to make them larger, but here the author differs. Actual tests show that reaming out flash holes to a larger size will slightly increase velocity and *greatly increase pressure!* Furthermore there will be a tendency toward primer leakage and the stretching of pockets with *normal* pressure loads. To verify these findings, the author asked the Hercules Experiment Station to try reaming flash holes oversize and report findings. The .270 Winchester cartridge was chosen for the experiment, non-corrosive priming, 130 grain bullet, and a full charge of HiVel #2. Normal flash-hole size is .080 inch, and this was tried,

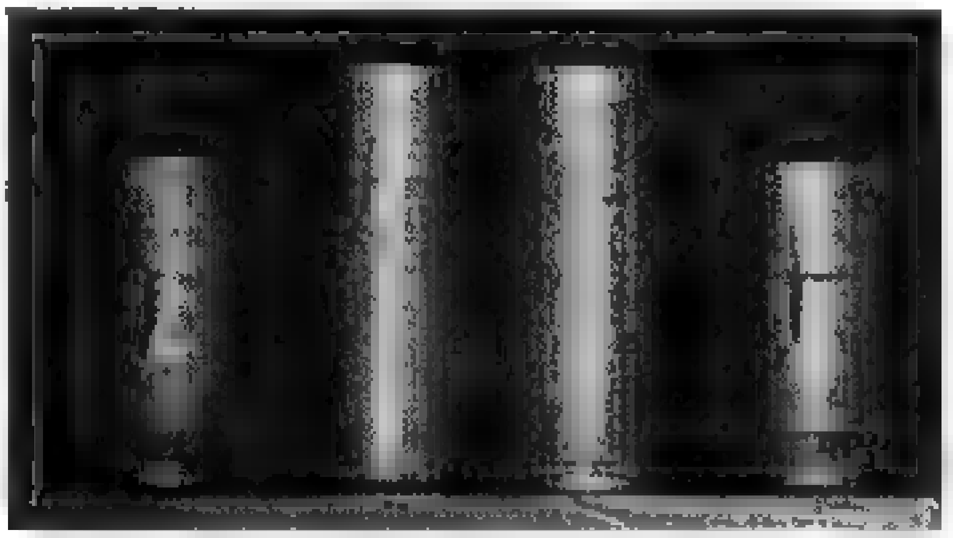
Mercuric primers cause these splits. Left, two Winchester mercuric primer 7-mm. cases, fired once. They showed no signs of split and resized excellently but the expanding plug split the brass in every shell. Right, mercuric primers rotted the brass of this cartridge case until it could be broken with the fingers

the loading being repeated with the vent reamed to .101.

With the normal flash hole, the maximum velocity for the series of twenty shots ran 3067 f.s. instrumental, with 2984 f.s. minimum. Average or mean velocity was 3036 f.s. Pressure tests for the twenty shots showed 56,600 pounds maximum, 50,400 for minimum and 54,600 for the mean or average. Using the same components, the flash hole was reamed to .101 and the test repeated. Maximum velocity jumped to 3138 f.s. instrumental, minimum was 3066 f.s., while the average was 3105, an average increase of 69 f.s. The real problem occurred with the pressures. Maximum jumped to 68,800 pounds, minimum was 58,000 pounds, while the mean ran 63,600, an increase of 9000 pounds with a velocity increase of only 69 f.s. These figures should be self-explanatory. Don't ream out your flash holes to larger than normal size. Such reaming as is necessary should be solely for the purpose of removing burrs.

Just what should these flash hole sizes be? A check made early in 1937 with the various ammunition manufacturers indicates that Western Cartridge Company has standardized on the diam-

eter of .0815 inch in all calibers, regardless of primer size. Winchester, on the other hand, uses, generally speaking, the diameter of .070 for all revolver and pistol sizes, including small rifle sizes, a diameter of .080 for all military rifles and general sporting rifle sizes with a single exception of the .220 Swift, which runs .060. Bear this in mind in the .220 Swift. The small-size flash hole is of extreme importance; excessive primer pressures are recorded where the large hole is used, and in many

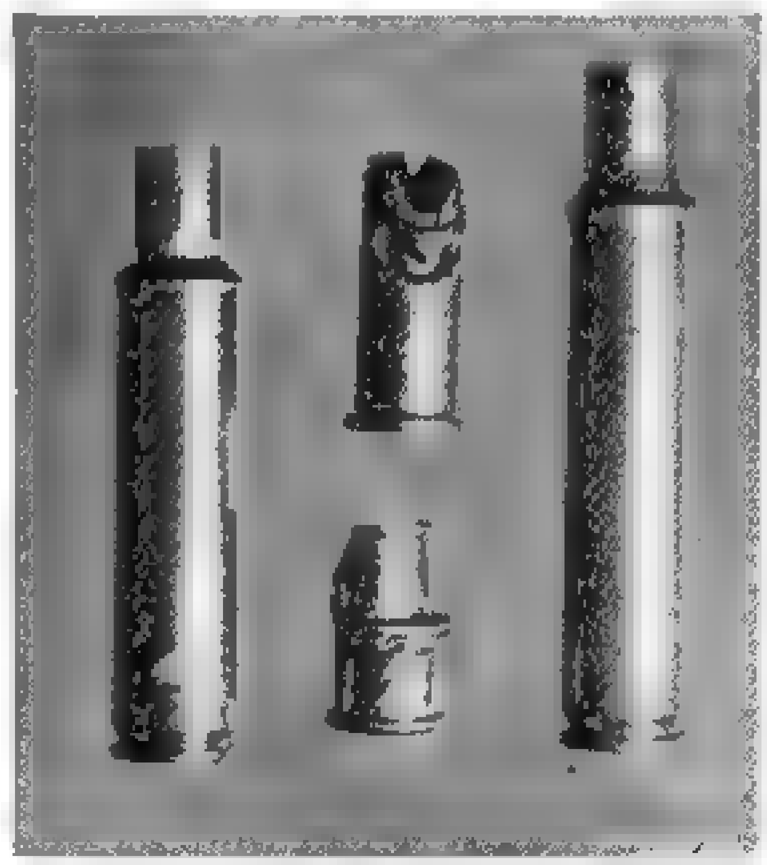


Mercuric primers frequently have the same effect as defective brass. The two .45 Automatics were defective brass of 1913 manufacture, the two .38 Specials were loaded seven times with mercuric primers

cases the primer drops out entirely, spilling gas back through the action. Ammunition made by Remington and Peters is standardized at .060 for all pistol and revolver sizes, .070 for all small-size rifle items, such as .32/20, .25/20, etc., and .080 for all military-rifle sizes. Here again the .220 Swift has a small-diameter flash hole measuring .060. Frankford Arsenal measures .078 to .082 in both the .30/06 and .45 automatic. Reloaders must bear in mind that these flash-hole sizes have been scientifically developed after considerable research and are the proper diameters for the particular make of primer originally used in the shell. To experiment with different primers, including those of a "stronger" nature, is inclined to build pressures rapidly, not only from the breech-pressure standpoint, but from the primer-pressure angle. This will cause the primer to flow back more or less, making the gun rather difficult to function, or what is even worse, may cause serious leakage or even blown-out primers. Very definite experiments have been conducted to verify this information. Do not alter the sizes of flash holes in any way. The only way to avoid this is to use the proper size of decapping pin.

Inspection of cases by the handloader will disclose that in various makes there are two distinct methods of perforating the primer pocket. Some makers punch the hole through from the inside of the case, others work from the outside. Each, of course, has certain advantages, but the importance of these is often exaggerated. It is easy to determine the direction of the punching, since the entrance mark of the punch is usually clean, while around the exit a crater is torn from the surrounding brass. These two different types of punchings may be found in different lots of the same make of cartridge case, and care should be taken to keep them separated.

Some flash holes, punched from the outside of the case, turn up a burr inside the cartridge case instead of tearing it off. This should be watched by handloaders, as it is a point which is *not* inspected at the factory. A ball-end punch, properly smoothed up, should be inserted in the mouth of the case, dropped to the bottom where it closes the flash hole, and *gently* tapped with a hammer. This will flatten the burr inside the case, and usually will close the flash hole. Many loads of reported "high-pressure" nature are actually normal loadings in which the burr around the inside of the flash hole has been partially closed by the decapping punch. The Bond Model C loading tool is a great offender in this respect. When you reprime your shells you support the cartridge case on the decapping punch with the pin removed, and then force the primer into the pocket with the



In sizing shells be sure you set your dies properly. The above cases were ruined through improper set-up

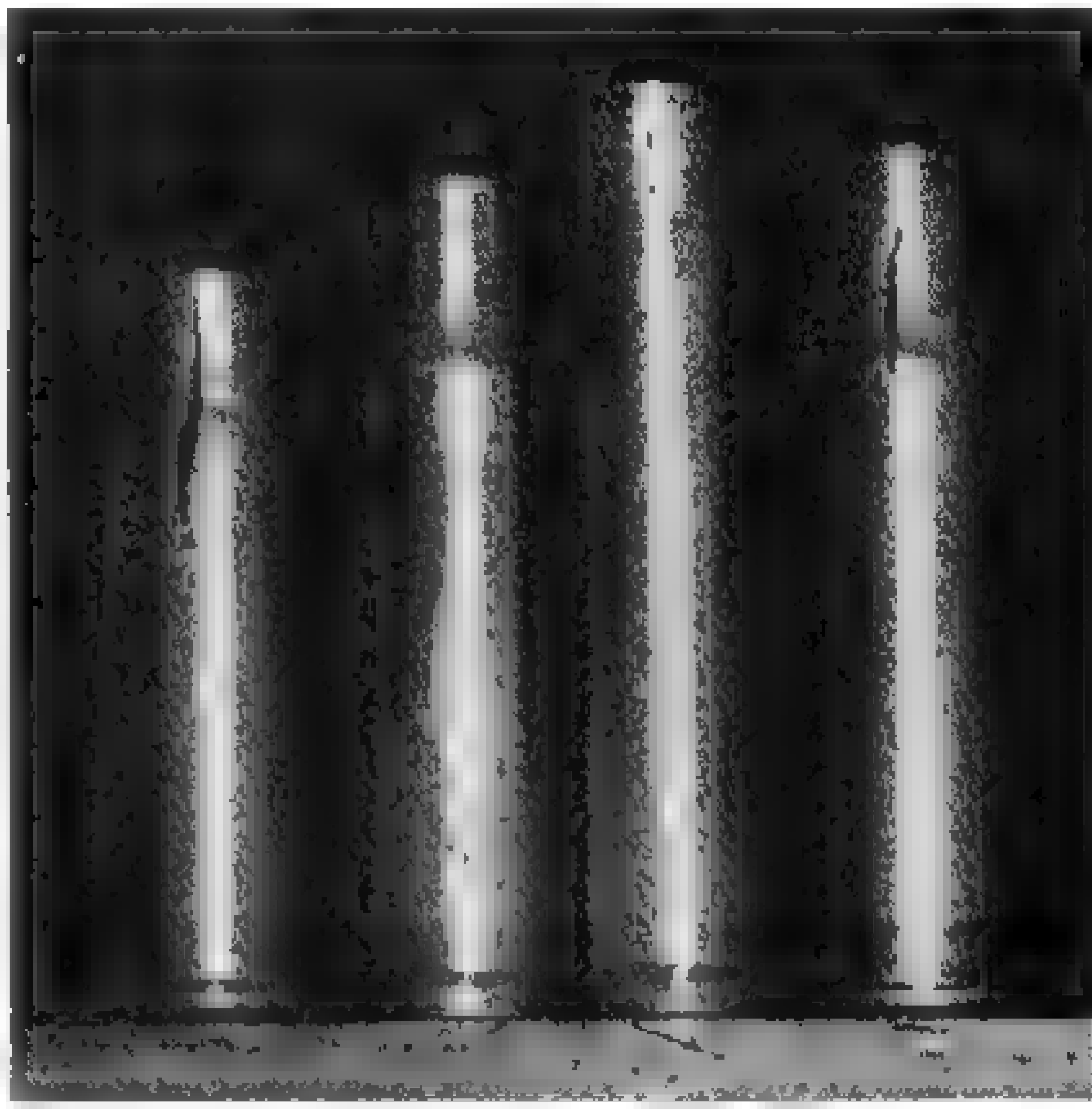
proper seating punch. If there is a burr inside the case, you are more or less certain to turn it over, and the writer has found certain cartridge cases in which an abnormal burr, turned up in the pocket perforation at the factory, had been folded down so as to seal the flash hole completely. *This would be dangerous!* It would cause the primer to blow out, and the cartridge might hang fire or delay its ignition until after the primer had dropped free of

the case, whereupon the bulk of the force of the gases would be utilized in the wrong direction; and instead of propelling the bullet at its normal velocity, would leave the cartridge case through the flash hole, entering the action and destroying everything, including the shooter's eyes. True, this happens very infrequently, but reasonable inspection will eliminate permanently the possibility of it ever occurring to you. See that your flash holes are free of obstruction. Also see that they do not leak, and, thirdly, do not ream them larger than factory specifications.

Just how strong is a primer? A number of years ago I was using some wartime .30/06/150 loadings which had on test proved to be exceptionally accurate. While these were being used on a government range in a National Match rifle, one shot "misfired." In accordance with habit, I waited a full minute to take care of a possible hangfire. There had been no noise other than the muffled click of the falling firing pin. Then we opened the action and extracted the cartridge. To our surprise, the primer dropped out and was lost —and the anvil dropped into the bottom of the magazine. The fired cartridge had in some way passed the inspectors and had been primed without a flash hole in the case. The force of the exploding primer, despite the absence of noise, had been sufficient to drive the cartridge into the chamber and shorten it about 1/16 inch, putting a perfect crimp or cannelure into the case body just back of the neck. The primer was the standard FA #70 mixture, of course. Don't ever underrate the strength of primers.

Crimped Primers. The crimping of primers is a source of sorrow to the handloader. Commercially, this practice has largely disappeared, but on military cases, built on Government contract, crimping is usually specified. Primer crimping takes two customary forms—the ring type and the three-point type. Frankford Arsenal uses the ring crimp on all rifle ammunition and the three-point "stab" crimp on .50-caliber machine-gun ammunition. A batch of Winchester 7-mm. 175-grain softpoint factory loads purchased by the author recently, was apparently made up of early loadings with the original Winchester Staynless primer, a mercuric type long since discarded. These had the ring-type crimp, but the mercuric primer itself ruined the utility of all cases, and experiments with resizing of these cases within a day of their original firings showed that nine out of ten split at the neck when the expander plug was inserted. The entire batch was discarded.

The ring type of crimp is performed with a knife-rim concave punch slightly larger than the diameter of the primer. It encircles the primer, contacting the head of the case, thus upsetting the brass by curling it over the primer somewhat. With most loading tools, it is a comparatively simple matter to decap these shells, but the primer itself is pushed out of shape in the process, the case crimp rarely upsetting to any appreciable extent. Therefore, to use these cases again, it is vital that the entire crimp be removed; otherwise the new



Cartridge failures. Left to right: 8-mm. Lebel poor brass; 7-mm. Winchester mercuric primer; .30/06 Remington, poor brass; .30/40 Krag-Remington, poor brass

primer will not enter the pocket. If the primer is forced past the crimp, it is usually badly distorted, thus causing misfires or hangfires. Primers are very delicate. They should always be seated to the full depth of the case and no traces of flattening, punch marks or other mutilation should be apparent. If extreme care is exercised in seating primers into crimped pockets, one occasionally may be able to force the tiny cup home without visible mutilation; but since the pocket is smaller at the top than at the bottom because of the crimp, leakage is certain to occur.

The answer, then, is to remove all traces of the crimp. Various individuals and several of the loading-tool manufacturers have in years past supplied special reamers suitable for this work. These are not exactly a success, since careless handling, twisting, canting, and so forth, can cause overreaming of the pocket. Such a case is ruined beyond repair. The chap with a reamer is inclined to be overconfident. He would do well to visit a

machine shop and watch the precision methods used to ream shallow cavities. He will soon learn that most of this delicate work is done in lathes, with rigidly held reamers fitted with proper pilots. If he questioned the truly expert machinist, he would learn that an error of two or three thousandths is very easy to make. Since the average depth of grooves in rifle barrels is a matter of three to four or five thousandths, he can readily see what a tremendous amount this small figure actually is. The primer-pocket crimps which cause all this trouble, are also a matter of but three to five thou-

Wesnitzer primer pocket cleaner used in a chuck. Shell head fits into socket of cage for quick cleaning. Note cleaner on bench with .38 Special shell

sandths, thus indicating the small amount of metal necessary to remove.

The skillful handloader can do about as well at pocket reaming with a sharp pocket knife as with the best-made reamer for this purpose. The knife *must* be sharp. In use the point is inserted into the pocket at not too great an angle, tilted as much as possible, held in position with a very short grip on the blade, and the shell rotated. *Do not move the knife.* Very little pressure should be applied, and the point of the knife should be sharpened at frequent intervals. It may be necessary to rotate the shell two or three times, but with practice a single thin shaving of brass can be stripped, removing the crimp. If the knife is dull, or too much pressure is applied, the effect will be a "chattering" which results in the removal of tiny chips and a wavy cut. This is not satisfactory, since it leaves high spots. Practice on some of your discarded shells and you will save a lot of good brass.

Care must be taken in this trimming of the pocket to see that the knife point does not come in contact with either the sides or the bottom of the pocket. Any scratches on the walls or bottom will cause leakage or improper seating of the primer. Take plenty of time, as the job is done but once.

A still better method of removing crimps is to use the special pocket swage made by C. V. Schmitt, loading tool maker of 915 Washington Avenue, Minneapolis. Mr. Schmitt is a rifleman who knows his stuff, having for many years shot at Camp Perry on various Minnesota National Guard teams at the National Matches. His idea is simple: A punch is ground to fit the original specifications of the pocket, a gadget holds the shell and prevents the operator from driving it into the pocket in other than a straight line—and there you are. It is a method easy to handle, speedy, and more accurate than any reaming system, since the results of reaming depend entirely upon the skill of the person performing the task, and are certain to be more or less variable.

Another problem of crimp removal is that of the three-point stab. This is occasionally found in some rifle cartridges, but rarely in handguns. Instead of a ring knife, three flat-end punches are driven into the head of the case at the edge of the pocket, thus upsetting a tiny segment about 1/16 inch wide at three points equidistant around the primer. This is quite simple to remove, and in this type a knife or Schmitt punch should be used. Despite the simplicity of the task, it does require special care, as a little carelessness results in the removal of too much metal or mutilation of the pocket.

Cleaning Primer Pockets. If non-corrosive primers are used, it is always wise to clean the primer pockets. Incidentally, this calls for decapping and cleaning the pocket as soon as possible after firing. The non-corrosive primers leave a hard brittle fouling that is extremely abrasive, and this forms a cake in the bottom of the pocket and is inclined to prevent proper seating of primers. If primers are not all seated to the same depth in a given group of loadings, uniform ignition cannot be expected; and without uniform ignition one cannot secure reasonable accuracy. A small bristle brush and a Handee Grinder are useful for removing this débris; but Lawrence Wesnitzer of San José, California, brought out in mid-1936 the neatest pocket cleaner we have seen. These little gadgets are manufactured in any desired caliber and for any desired pocket size. In addition he makes separate brushes to fit in a 1/8-inch chuck of the Handee Grinder.

The special pocket cleaner is a socket containing a disappearing stainless-steel wire-bristle brush. In use, this unit is mounted in the chuck of a small twist drill or on an electric motor. If the twist

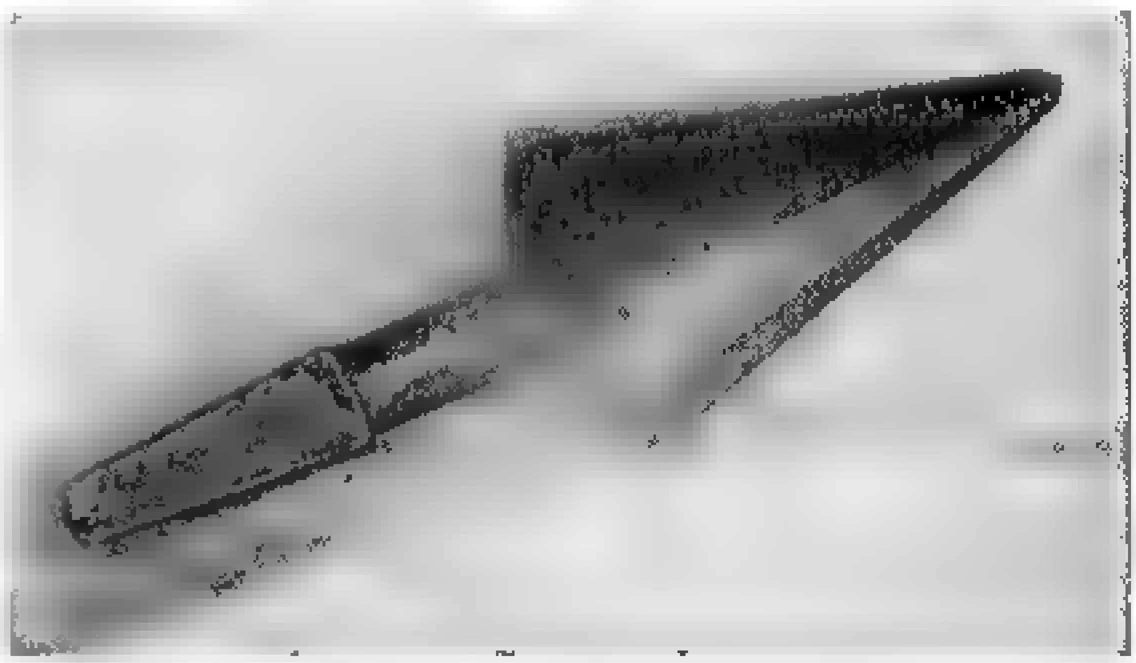
drill is used, the drill is clamped into a vise and the unit spun slowly. The head of a cartridge case is then pressed into the proper socket and gently forced home. This causes the bristle brush to enter the pocket and completely wipe out all traces of flaky débris, all within an instant. Several of these have been in use by the author for more than a year for the .30/06, .38 Special and .357 Magnum, all with a large diameter of .211 primer. They show very little wear despite the cleaning of at least two thousand odd cases. Wesnitzer makes these brushes out of best-grade stainless-steel spring wire. Consequently they are impervious to the action of primer acids. The cage or housing is made of light aluminum, and therefore does not corrode readily. The unit will last indefinitely with reasonable care, and the cost is extremely low.

In the absence of equipment of this nature, a small screw driver may be used to remove the caked-on débris. Be very careful not to injure the sides of the primer pocket or the usefulness of the shell will be destroyed.

Bullet Crimps. A bullet crimp is merely a means of holding the bullet in the neck of the cartridge case. In a great many military and sporting cartridges which do not use a cannelured bullet there is no crimp at all, the bullet merely being seated into the case mouth friction-tight. On others there are various types of crimps, from the simple bevel crimp on the mouth, through ring, split ring, stabs, grooves and what-not. To the reloader this is a problem which must be met. The original crimps must be removed from all cartridge cases before they can be used to good advantage. On rifle cases of the bottle-neck variety this problem is nil, so far as so-called "neck crimps" are concerned. A number of assorted bullet crimps are found on case mouths either of straight, straight taper or bottle-neck variety.

There are essentially three types of bullet crimps used on bottle-neck cartridges, particularly with metal-jacketed bullets. The simplest of the lot is the "turn-in" type, such as can be accomplished with various handloading tools now on the market. The turn-in crimp is accomplished by pushing the loaded cartridge into a die having a tapered shoulder in a neck relief slightly shorter than the length of the uncrimped case. When the case is pushed into this bevel, the straight mouth is crimped or turned inward, usually into a cannelure or relief ring in the metal-jacketed bullet designed to hold it, much the same as the "crimping groove" in cast bullets. Frankford Arsenal is using this type of crimp on all recent loadings, as are the majority of commercial makers on cannelured bullets.

Another type, usually found on cases for uncannelured bullets, is the "split-ring" crimp. This is accomplished by using a split die—usually in three sections—which encircles the mouth of the case, the surface of the jaws being parallel to the axis of the bullet. These jaws are clamped together, thus constricting both case and bullet slightly. The different segments of the jaws do not quite touch each other, however, and therefore this type of crimp is readily identified. Sometimes a two-, a three-, or a four-segment die will be used, but the three is the most common. This type of crimp is difficult to remove, and my advice to handloaders is to ignore it. Resize and expand cases in the normal way, chamfering, if necessary,



An inexpensive shell mouth reamer for all calibers is a 1¼-inch plumber's pipe reamer. This may be held in the hand, and shell mouth twisted in the fingers

and despite the fact that the crimp can still be faintly seen, even after several resizings, it usually will cause no trouble. Therefore the problem is more imaginative than real.

The third bullet crimp is a pest—the "stab" type rarely found on commercial ammunition, but rather frequent in rifle and pistol cartridges of military extraction; even commercial makes manufactured on Government contracts occasionally use this. In this type of crimp, the jacketed bullet is held in the case neck by means of three stab marks in the neck, equidistant around the circumference. The stab dents extend through the brass and into the jacketed bullet as well. Recovered bullets which have been crimped in with this system can readily be identified, as the marks will plainly show. The stab further remains in the case neck, refusing to "iron" out even under the high pressures of a military rifle cartridge. Put through resizing dies, this stab steadfastly balks sizing attempts, although it will iron out somewhat. Even repeated firings fail to remove it entirely, and sooner or later the brass, weakened by the stab will crack or puncture at that point.

The best way known to the author for overcoming the resizing problems of stabbed cases is to utilize a short piece of drill rod—cold rolled will do—of a size which will fit loosely into the neck of the fired case. Clamp this solidly in a vise so that a half-inch or so projects horizontally. Then slip the case neck over this projection, rotate it until the stab mark is upward, and using the rod as an anvil, gently tap out the dent with a light hammer. All three stabs are removed in this manner, whereupon the case should be properly resized and loaded. After the first firing most traces of the stab will be gone, as will all the troubles of mutilated or tipped bullets due to the presence of stabs. The process is a nuisance, but is not very complicated.

Satisfactory handloadings cannot be had with cases before the removal of stabs. In seating the bullet, if of the jacketed variety, the base comes in contact with the stabs in such a way that either the case neck is bulged unevenly, or the bullet is tipped slightly in riding over the elevation inside the neck. This means that a badly unbalanced cartridge will result, the bullet starting off tipped—and no tipped bullet will do good work. Also the seating of the bullet will bulge the case neck in spots, as the bullet endeavors to displace the brass of the case, which will result in uneven bullet tension, causing irregular velocities and pressures. And the sad part is, that these bulges often make it impossible to chamber the cartridge in a closely chambered barrel. If cast bullets are used, the bullet is grooved where the stabs plow into it, and such a bullet is inclined to leak gas. This can start erosion in the barrel, and at the least, will mean very poor accuracy.

Foreign Cases. The average handloader will deal with only American cartridge cases, primarily because foreign cases customarily use Berdan-type primers, and are therefore not reloadable. On the other hand, a great many military cartridges available in this country were manufactured for foreign governments during war periods and are primed with conventional forms and sizes of American primers. During the World War, for instance, the 7.62-mm. Russian, 8-mm. Lebel, .303 British, 6.5-mm. Mannlicher-Carcarno of Italy, 6.5-mm. Greek Mannlicher, and similar cartridges, were manufactured by our various commercial firms under war contract. Though these were intended for foreign consumption, many of them leaked out into this country and the shells became available in limited quantities for the ambitious handloader.

It is well to bear in mind, however, that these cartridges used crimps to meet the specifications of foreign governments. The British crimping system consists of short circumferential stabs. Cartridges loaded for the Russian Government (also .45 ACP cartridges and some .30/06 numbers loaded for the American Government) were crimped with circular stabs. Italian Mannlicher-Carcarnos used triangular stabs driven with a flat-nosed punch into a cannelured bullet, while a few others used various experimental stabs or complete ring crimps in the middle of the neck, which depressed the case neck into a cannelure of the bullet. American practice is either to seat the bullets friction-tight (with the exception of the above-mentioned examples of war contract for the United States Government) or to crimp the mouth into a cannelure on the bullet. The American system is, in other words, generally ideal for the handloader, causing no serious trouble. Occasionally, however, factories experiment with various methods of holding bullets in position, and the handloader who gets samples of these particular shells is merely out of luck.

Case Cannelures. Another problem in case manufacture which causes trouble for the reloader is the body or neck cannelure used by many of our ammunition makers. In the majority of cases there is no excuse whatever for this groove in the brass case. Many plants feel that it dresses up the cartridge case—certainly it does no particular good. Originally, as in a great many other obsolete practices still in use, there was an idea behind this cannelure business. The old black-powder guns, with their tubular magazines, held the cartridge under spring tension, bullet to primer. The recoil of the old smoke wagons would cause the soft lead bullet to pull forward slightly, and then spring back. The crimp was supposed to clamp solidly against the middle of the bullet and prevent it from pulling out; while a cannelure was placed in the case as a bullet stop to prevent the lead slug from being set back into the case too deeply.

At one time the Ideal Manufacturing Company had in its line of loading tools a three-point stab crimper known as the "Ideal Shell Indentor." The idea was to stab your pet cases deeply at a specified point, so that bullets could be seated in the case until they touched the stab marks, thus eliminating the necessity for crimping good target loads. This was an outgrowth of factory-case canneluring practice.

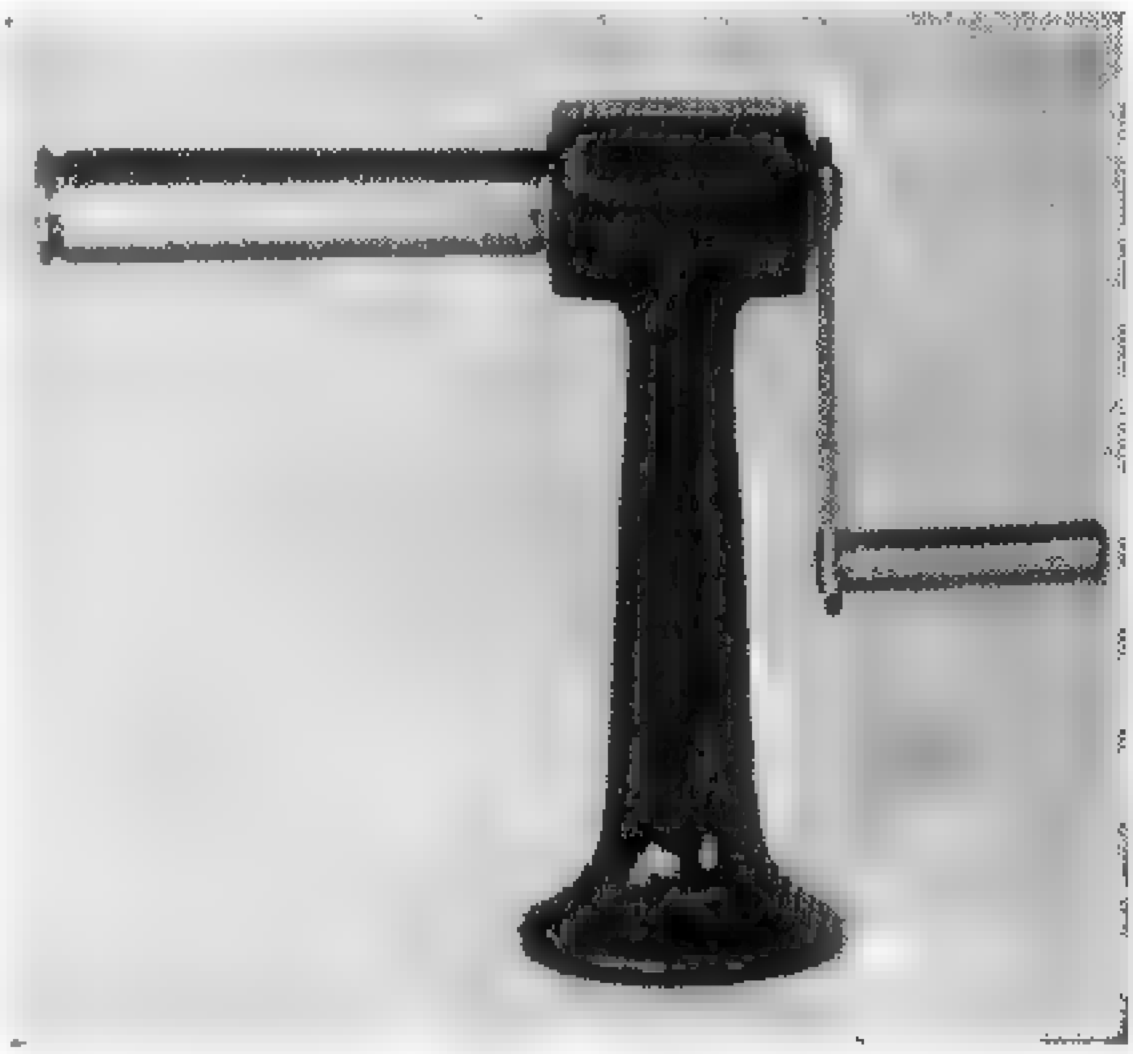
Without a doubt, at least in the mind of the average shooter, a cannelure dresses up the appearance of a cartridge case, particularly those cases having a long straight body or faint bottle neck. Most revolver cases are cannelured, the idea being

that while it forms a bullet stop and dresses up the case, it also serves as an identifying mark, since the same makers frequently load handgun cartridges with black or semi-smokeless powder. The latter are invariably left plain. With such cartridges as the Hornet, there is absolutely no reason for the cannelure, and it is a very special nuisance. The handloader is limited in his choice of bullets before the cannelure has ironed out, since they do not seat well beyond this ring. Furthermore, as the groove does iron out, the case lengthens, necessitating trimming for best results. There is no practical rule for removing this ring. Shoot, resize, shoot and resize again. It will gradually iron out. Better still, buy plain cases; but they are not always available.

Case Anneal. Never experiment with case anneal. This is a problem for a metallurgist and cannot be successfully solved at home. Cases are given the proper temper at the time of manufacture. If they are annealed at home by heating, the result will be very unsatisfactory and may even be disastrous. Remember, there is a lot of action going on inside that case at the time the firing pin falls. Keep it in there. Soft or spotty annealing will result in sticking cases, rupture, stretching, and other ills. Rupture is bad business, as it means that a certain amount of the gases generated is coming back through the action instead of leaving in the normal way through the muzzle. Even if you have no friends or relatives, remember that the fellow standing around watching the firing may have a proud mamma, and she may not be as proud of him after you get through. As a matter of fact, you might not look so good yourself with a piece of a bolt projecting from your right eye socket. Leave the case annealing to the factories.

One occasionally finds a marked difference in the anneal of different makes of cases, or different lots of the same make. The difference is slight, yet marked in performance. If factories turn out occasional soft or hard cases with their constant inspections by an elaborate staff of chemists, metallurgists, and complete laboratory facilities, what do you think of the possibilities of "home talent"? Manufacturing specifications permit of a certain tolerance, and cases are designed for a certain pressure class. If cases built to function with 35,000 pounds pressure are used in a special rifle in that caliber capable of handling 50,000 pounds, something may happen to the case despite the strength of the rifle.

A paragraph quoted from a letter written the author by Mr. L. C. Weldin, Ballistic Engineer of the Hercules Experiment Station at Kenvil, N. J., throws an interesting light on the weak case problem. Says Mr. Weldin: "Most people do not seem to realize that burst or damaged guns are more frequently caused by *weak cartridge cases* than by weak or defective guns. We have fired the .30/06 Springfield rifle at pressures of 80,000 and 90,000 pounds without any appreciable damage to the gun. We have damaged the same type of gun so that it could not be repaired with pressures of



The Jordan case trimmer. The cartridge case is stopped in its socket by the shoulder. Brass is trimmed to proper neck length on turn of the handle

only 60,000 pounds when we encountered a weak case. You may shoot hundreds of rounds in any gun with cartridges giving higher than normal pressures and never encounter trouble. On the other hand, a normal heavy load may injure both you and the gun if fired in a poor or weakened cartridge case." Ammunition makers are constantly striving to keep those "poor and weak cases" from getting into regular production. When you find cases indicating these abnormal traits, *junk them promptly!*

Mail-Order Cartridges. And do not attempt to reload this very excellent (?) mail-order ammunition. The author, in his capacity as a firearms editor, has had many samples of cases submitted to find out "what's wrong with my gun." Many of these troubles can be traced directly to the cases. Mail-order cases are cheaply made, regardless of the claims of the firm which sells them and "guarantees" them. Before me as this is written is a group of cases submitted by a reloader personally unknown to me. He wrote: "In reloading some new shells, fired once, the first five shots blew up,

the fifth shot causing me to call it quits. I was using one of those new Winchester 54 rifles chambered for the .30/30 bought in the original sealed factory carton at an unusually low price. I thought things were funny that I could buy a good 54 at less than $25. What's the matter with these guns?"

Naturally we asked for some of his cartridge cases. He replied that he had thrown away the "blown up" ones, but had some which had never been reloaded, and hence had been used "only once." Once was enough. This brass bore the simple designation on the head, ".30/30." No maker's name. The shells were so weak that with a pair of pliers on the head, and another on the body, I could break them in two at the junction of the solid head and side walls. The walls here were very thin; a too-sharp punch had been used in the drawing or head-bumping—*and* they had had a mercuric primer. Every shell showed signs of pending rupture after that first firing, and one of the factory loads had developed a partial rupture. Yet he wanted to reload these! There was nothing the matter with his rifle. Winchester, having one of the brainstorms that sales departments occasionally get, made up a big batch of Model 54's in a caliber which would appeal to no bolt-action rifleman. Being stuck with them, they dumped them on the market at a price which enabled shooters to pick up a real rifle for a song. Yet this mail-order ammunition, poorly built of poorer brass, had caused one shooter to lose faith in his gun. We blush to think what might have happened had that chap used his reloads in a well-worn lever-action model with plenty of headspace and spring to the bolt mechanism. Probably we never would have heard from him—directly.

Mail-order ammunition is built of good materials through a system of short cuts, said short cuts saving the makers much money. Inspection of the product during and after manufacture is scanty and incomplete, and since this is an important figure in ammunition cost, the saving of these little necessities means a great many dollars saved. Tolerances are wide, tools which would not pass regular inspection are used, a few annealings are eliminated. The result is that while the uninformed shooter pays less money for a box of mail-order cartridges, *a much higher profit is made on it* than on the regular grade A product. Inspection of ammunition, which includes the cost of testing the completed product, *actually doubles* manufacturing cost. Put another way, it costs as much to inspect ammunition through its various manufacturing stages, and in testing samples of the finished product, as it does to *make* it. Steer clear of mail-order fodder; but if you must shoot it, don't reload the empty cartridge cases.

Case Strength. What makes one cartridge case stronger than another? That's rather hard to say. There is more to the design of a cartridge case than its outside measurements; the inside, where most of the action is going on, is of major importance. Case walls must be of a certain thickness; the shape inside the head and around the flash hole is definitely arranged, and the head thickness, or web, is definitely determined. Given a case of certain external measurements, the thickness of the walls, head, and taper of the interior will greatly affect loading density. Loading density and capacity of the case in turn affect velocity and pressure. The thicker the walls, the less the capacity of the case.

Actually, the loading density of a cartridge case is the relation of the normal charge of powder to remaining air space left in the case after the powder is inserted and the bullet seated. Wall thickness is usually controlled by the type and level of pressures at which the cartridge is designed to operate. It is also controlled by the shape of the case and, to a certain extent, by the powders to be used. Some powders ignite in such a way that in certain cartridges they create what is technically known as a "high base pressure." This means that the pressure generated at the head of the case is greater than at the mouth. The result is that cases designed for such powders are quite thick in the head and sidewalls.

This high-base-pressure problem is one which concerns the handloader more than the manufacturer. The latter, with his great laboratory facilities, is able to get the desired results chiefly through the adaptation of proper powders to his problem. Therefore, when the handloader experiments with different powders he should bear in mind that he can create unsatisfactory pressures at the head of the shell and thereby cause complications in the form of stuck shells.

Cases should extract from a chamber without undue effort when used at the normal pressures for which the cartridge is designed. Soft heads, or heads with thin sidewalls, will bulge in the chamber and stick. Such cases, if you happen to find a batch of them, are suitable only for reduced loads.

Case Capacity and Pressure. Some years ago logic drove home a vague idea that since a fired cartridge case expanded to fill the chamber, it increased in inside size; therefore it should give different velocities and pressures. We no sooner had the idea than we endeavored to run it to earth.

Since the .38 Special was a handy proposition to experiment with, a test was run at Burnside Laboratory to determine the difference between new factory cases and reloaded ones.

The figures are quite interesting. Winchester 158-grain factory bullets were used; also Winchester cases primed with #108 non-mercuric non-corrosive primers. The charge was 5.0 grains of cannister lots of Du Pont Pistol Powder #5. Instrumental velocity over a 50-foot range ran 891 f.s. mean with the new and previously unfired cases. They were then reloaded without resizing. Velocity averaged 887 f.s.—some four foot-seconds loss. The new cases, however, gave a mean breech pressure of 14,500 pounds, while the reloads averaged 13,000 pounds—a loss of 1500 pounds! This is decidedly worth knowing. The loss in pressure is undoubtedly due to expansion, which increased the shell capacity and loading density. No, we have never tried it on high-power rifle stuff. No reason why it shouldn't work out similarly, though. The so-called Mann-Niedner chambers—which are essentially very tight chambers—are known to create higher pressures than normal with a given cartridge, but this test in the same chamber is a revelation.

V

ALTERATION AND ADAPTATION OF SPECIAL CASES

PERHAPS the biggest problem in the handloader's list of trials and tribulations is that of loading for special foreign calibers. Also trying to keep his old-timer in working order. Foreign cartridges invariably cost a great deal of money. They are imported in small quantities, and therefore import charges are extremely high. Duty raises the price as well, and after all, the handloader is never content to use factory loads exclusively in any one gun.

Decapping the Berdan Primer. The major problem of importing components for handloading is the fact that your cartridge cases are invariably primed with the Berdan type of primer. This makes them difficult to reload, and it is absolutely necessary that the handloader acquire some form of Berdan decapping tool. He can usually obtain this from some foreign country: the manufacturers of ammunition in Europe will be glad to assist him in locating one. He will also do well to obtain a plentiful supply of primers to fit his particular caliber.

All this sounds extremely simple, but it runs into real money. I recall a personal experience of a few years ago when I was experimenting with the 7-mm. rifle in an effort to obtain the maximum loading with bullets superior to those manufactured in this country. I purchased several batches of German bullets manufactured by R.W.S. and also by D.W.M.; brought them into this country, and then started to figure the damage. It cost approximately 7 cents each for those bullets alone—200 bullets cost approximately $14 by the time the express charges, duty, customs brokerage, insurance, and other complicated charges were added together and tied to the original invoice. Only a year ago I attempted to duplicate some of this experimental work, and I blush to think back over the total cost of the job, particularly as the American dollar was then worth only 60 cents in German marks.

The handloader, therefore, should bear in mind that wherever possible it will be practical and economical to use American components. Loading tools, resizing dies, and so forth, of various foreign calibers, are often difficult to locate. On the other hand, it may be possible to obtain one of these in the tong type from Ideal. They have a great many tools not generally catalogued, and it would pay the experimenter to write direct to the Ideal Manufacturing Company, Middlefield, Conn., before he attempts to have additional accessories made for his standard loading tool in some odd caliber.

It is well to bear in mind when you experiment with foreign cartridges that you are working against peculiar odds in attempting to duplicate the velocity listed. The average shooter has rebuilt his foreign military or other foreign arms into a Sporter of American standard. He has adopted a barrel length of approximately 24 inches. Despite the fact that many of the cartridges for which he may desire to load were designed to be shot in 22- to 24-inch barrels, much of the laboratory test work, particularly with regard to velocity figures, is achieved by using a 30- to 32-inch barrel. Roughly speaking, then, it would be well for him to deduct from 150 to 200 f.s. from the factory rated velocity if he endeavors to duplicate the factory specifications in the handload.

Bullets. The real problem of the handloader is to utilize as far as possible American components in assembling his loads. The first thing to do will be to slug the barrel, to determine the groove diameter, and then choose from the list of American bullets the one that best fits this bore. The bullet may be as much as .0015 oversize. If it is, of course, pressures will be unusually high and velocities low. It may be undersize without creating serious problems of erosion, accuracy, or high pressure. I have seen some excellent results with jacketed bullets shot in barrels which were as much as .003 too large for them. This is not generally recommended, however.

There is a great deal of argument as to the value of undersize and oversize bullets in various obsolete calibers. This question has never been satisfactorily answered, but the fact is that European nations frequently get excellent results with subcaliber bullets and the extremely deep rifling used in most foreign guns. They claim that upsettage of the bullet delivers the finest possible accuracy and eliminates the bugbear of accuracy—fins on the base of the bullet.

The major problem in reloading for these odd

cartridges, other than that of priming, is that of obtaining proper case sizing dies. Since these calibers are either obsolete or not standard in this country today, there will be more or less difficulty in obtaining them. On the other hand, it is a problem not merely of obtaining loading tools but of adapting them to your particular needs. Frequently it is necessary to make a sulphur cast of the chamber of your gun and send this in to a loading tool manufacturer. If you use various sizes of bullets, including imported or American sub-caliber sizes, you will need a small neck-sizing die or small expander plug. If you desire to use full diameter bullets, you can obtain them in this country, but a different size of expander plug will be necessary. And if you would like to experiment with slightly oversize cast bullets, still a third plug will be required. With certain types of tools, this does not entail a great deal of expense. In others, it will be extremely costly, particularly as the various accessories must be made to order.

There is one important feature which the handloader should not overlook. Certain foreign cartridges do not require a complete additional set of tools for handloading. The 7 mm., 8 mm., 9 mm., and similar Mauser cartridges have the same diameter head. Therefore, shell holders for the .30/06, .270 Winchester, and assorted American types of that nature will properly handle this and several other foreign calibers.

One of the author's friends uses a Pacific tool. Desiring to experiment with certain foreign calibers at a minimum of expense, he had an expert manufacture for him, at small cost, an adapter for his Pacific tool which would permit him to screw the Ideal standard double adjustable chambers into the tool body. These chambers, of course, do not cost quite as much as other makes of resizing dies. It is, therefore, necessary for him to obtain for any particular odd caliber merely a resizing chamber and a bullet seating die.

Obsolete Cartridges. Occasionally the handloader and experimenter, in his wandering around, stumbles over an excellent buy in some old-time specimen of rifle. He may pick up an old match gun in perfect condition, one with a heavy barrel and an excellent assortment of target sights. To say that it is impractical to load for such a gun, and thus restore its usefulness, would be absurd. If the gun once did excellent shooting and is still in good condition, it is capable of duplicating its original performance.

My good friend C. L. Cummins, designer and builder of the famous Cummins Diesel engine, is an ardent shooter who visits the National Matches regularly and does his goodly share of shooting. He is not content to experiment with the modern guns, but is at present playing around with old Sharps rifles, gathering up various calibers in excellent condition and endeavoring to develop handloads using smokeless powder. "The reason why I am chiefly interested in smokeless powders," he confides, "is that with the black powder loadings I have been able to obtain, the cartridge is extremely noisy and dirty when fired indoors." We can readily imagine this. Some of those old-timers would sound like a blast of dynamite if fired indoors.

If you pick up any of these old rifles, you may find it a bit difficult to locate cartridges for it. Bullets are a rather simple problem. The Ideal Manufacturing Company (now Lyman Gunsight Corporation) has thousands of cherries in stock in the old and obsolete calibers and weights, and although they do not usually stock these bullet moulds, they can arrange to supply you on order. It is wise to write them direct regarding any contemplated loads in a given obsolete caliber.

If you can find any old loaded ammunition, the first thing to do is to tear it down rather than to fire it. These old black-powder numbers often are loaded with a coarse granulation of powder which has long since crumbled and caked into a solid mass. If the primers have not gone bad, accuracy will be terrible and recoil terrific if this caked-up charge of powder is used. About a year ago I had an opportunity to shoot a few rounds in the old Sharps Buffalo Gun in .50/120/550. Some of the original factory loadings by UMC were in perfect condition, but the breakdown test showed that the powder had caked solidly. A few handloads duplicating the original load were tried, and there was a vast difference in the recoil of the two different lots of ammunition. From an accuracy standpoint, the verdict is still in the air; for of all the big-game rifles this author has ever tried, that old Sharps bull gun—with the largest and longest cartridge ever manufactured in America—was far too energetic on the south end to induce accurate rest shooting. As a matter of fact, the author has been heard to confess that on the first shot he left the shooting bench entirely, and from a comfortable sitting position, suddenly changed to a most uncomfortable prone position not at all in keeping with the dignity of his office.

There are a large number of American cartridges which can be reformed to fit the old-time rifles. It is also possible to obtain odd cartridges for reloading purposes from some of the larger dealers in obsolete goods. Among these are Fran-

cis Bannerman, the Hudson Sporting Goods Co., J. Warshall, and many others that advertise regularly in the sporting magazines. If you go in for this type of thing, however, buy your cartridges in quantities and demand lower prices than the ordinary list prices. The dealers will be glad to sell them.

Some authors recommend the use of imported cartridge cases for reforming purposes. This may or may not be advisable. It is a question of much doubt. Most of these foreign cartridges are Berdan primed, and as previously mentioned, this creates problems of its own. Some writers even insist that the twin flash holes be drilled out to 1/16 inch diameter and a special decapping rod made with two little 1/16-inch pins in one end. This decapping rod, in turn, is dropped into the cartridge case, twisted until it finds the proper holes, and then used to drive out the old primer. This practice is absolutely dangerous and invariably results in serious damage either to the handloader or to the gun, or both, if its practice is persisted in. Generally speaking, 1/16 of an inch is a sufficient diameter for any flash hole, and if two pins of this size are used, the charge of powder will invariably be over-ignited, and this in turn will create a form of detonation that may be dangerous. If nothing else happens, the much larger area of the twin vents will offer so much more surface for the powder gases to back up, and an action which will perform normally when proper ammunition is used will, under these conditions, require a complete rebuilding of the breech mechanism with rebushing of the firing-pin hole and a smaller and more modern type of firing pin. Even then, the results will be a compromise. The foreign factories, in using twin or triple flash holes, as they occasionally do, pick that needle-fine diameter for a very definite purpose; the area of a flash hole has been definitely figured, and they know well the problems which will arise if they use multiple flash holes of too-large diameter.

It is frequently possible to use these Berdan-primed cases by dint of much work on the part of the handloader in reforming them to handle American sizes of primers. C. V. Schmitt, of Minneapolis, Minn., maker of the Schmitt loading tool, also manufactures a primer pocket swage designed for moving the crimp from Springfield cartridge-case pockets. It is quite possible that he would, at a reasonable charge, manufacture one of these to order, so that a slightly undersize foreign primer pocket can be properly opened to handle American primers. Of course, the standard swage will serve if one desires to use the regular diameter .210 primer such as is used in the .30/06. This particular pocket can also be used in handgun sizes for such primers as the Winchester #111 handgun diameter .210.

If a punch like this is used, do not, under any conditions, drill out the Berdan anvil in the bottom of the primer pocket. Use a swage instead to flatten this out, as in most cases this anvil is pressed in from the inside of the cartridge case. The case, of course, should be supported on some form of rod anvil during the process of reforming the primer pocket. This surplus material will also spread sidewise somewhat and plug up the regular flash holes. If the job is done intelligently, these holes will close up practically entirely and will remain in that condition for a great many handloads. Meanwhile, a single flash hole in the center can be drilled. It should be drilled with a maximum size of 1/16 inch. It is preferable, if possible, to drill this hole somewhat smaller; .06 inch is far more effective for a smaller primer pocket.

For all initial experimental work in a given caliber, try first to duplicate the original black-powder factory loading. Instead of increasing the power, which may be dangerous in these old guns, it may be wise at that point to decrease. Either black or smokeless powder may be used, but in all cases, suitable bullets must be employed. Information on bullet casting and paper patching for those who desire to experiment with this in the old-timers, will be found elsewhere in this volume.

Old-Time Rifles. These old-time black-powder rifles offer an excellent field for experimentation with smokeless powders. We say this with restrictions, however, and the restrictions are of extreme importance. Do not expect to duplicate black-powder performance at first, and always bear in mind that black and smokeless powder pressures are entirely different, much as are their performances in other respects.

Good powder for loading the old-time guns in the smokeless field is the now obsolete but frequently found Du Pont Schuetzen. Other good numbers are the bulk series of Du Pont #1, #2, and several other so-called bulk powders. For midrange use, Du Pont #75 and #80 can be loaded to excellent advantage, but in no case should these latter powders be used for full charge assemblies.

Hercules dense powders such as Lightning, Sharpshooter, and Unique also perform excellently in black powder calibers. Lightning and Sharpshooter in particular will permit of full charge loading in a great many of the old-time cartridges. As a matter of fact, these two powders were

brought out at the end of the century by Laflin & Rand chiefly to replace black powder in these large-size cartridges. Sharpshooter was born as a replacement for black powder in all calibers from the .22 Winchester Center Fire (the early version of what is now known as the Hornet), up to the big .45/90. It worked excellently in all these cartridges, including a great many of the obsolete black-powder numbers since discontinued. Lightning, on the other hand, while it works in a number of old-timers, was designed at about the same time for use in the then modern small-bore military cartridges, particularly the 7 mm. It performs excellently in all forms of bottle-neck cartridges of medium and large size, although it is widely used in the .32/20 Winchester and similar small-size numbers. It can be used in the .38/40 and .44/40 rifles, but does not burn well in the short barrels of handguns.

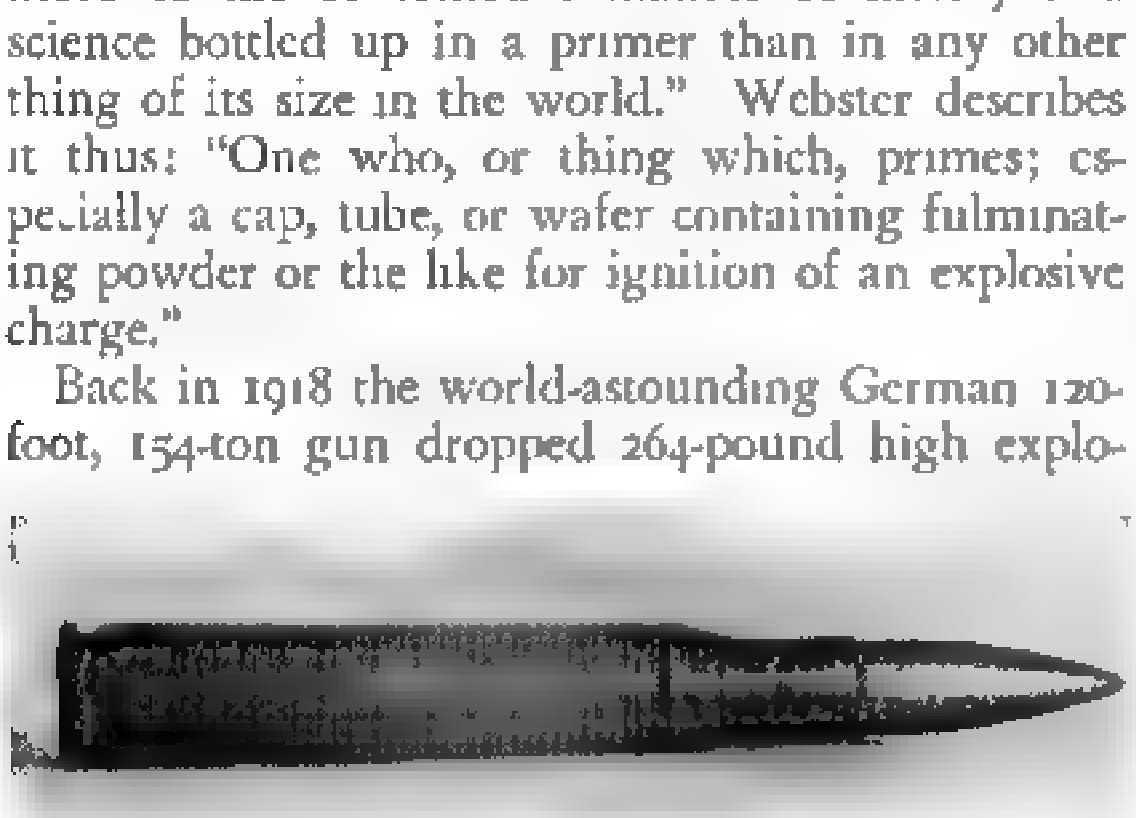
It is well to bear in mind that these early barrels, despite their apparent strength, are made of much softer steel than the present ones. On the other hand, a great many Winchester barrels of that era were made of nickel steel—Winchester pioneered the nickel steel rifle barrel idea commercially, although it was used in the Blake about 1896. These early barrels will wear more rapidly than the later types, and smokeless powders are inclined to be extremely erosive on the soft metal. A few of the Du Pont powders can be used with reasonable success, but extreme care should be used, as these powders invariably develop pressures—when loaded anywhere near their normal working level—far in excess of the permissible pressures of the early guns. Loading for obsolete guns is by no means a beginner's job. It is a task for the experienced handloader, and the man who has played with the more modern calibers will get a great deal of satisfaction out of his experimental work with resurrected specimens in good condition.

VI

PRIMERS—DEVELOPMENT AND MANUFACTURE

THERE is more real romance wrapped up in the little primer of your cartridge than in any other single development of firearms science. The late Dr. Paul B. Jenkins, of the Milwaukee Public Museum, went so far as to claim that "there are more of the combined romances of history and science bottled up in a primer than in any other thing of its size in the world." Webster describes it thus: "One who, or thing which, primes; especially a cap, tube, or wafer containing fulminating powder or the like for ignition of an explosive charge."

Back in 1918 the world-astounding German 120-foot, 154-ton gun dropped 264-pound high explosive shells in the city of Paris some 76 miles away, a feat never before—or since—equaled! These eighth-of-a-ton shells were driven by the appalling charge of 432 pounds of smokeless powder. Some 154 pounds of each load was contained in an immense brass base shell with an electrically ignited centerfire primer. The rest of the load was inserted first in two silk bags so that the various charges were ignited separately during the long barrel travel to get a true "progressive burning" of the charge.



Primers have a greater strength than many people realize. No flash hole was punched in this cartridge case, and it got by the inspectors. This wartime factory load was then "fired" in a Springfield rifle. The force of the primer failed to ignite the powder, of course, but it drove the cartridge case into the chamber and bulged it as shown

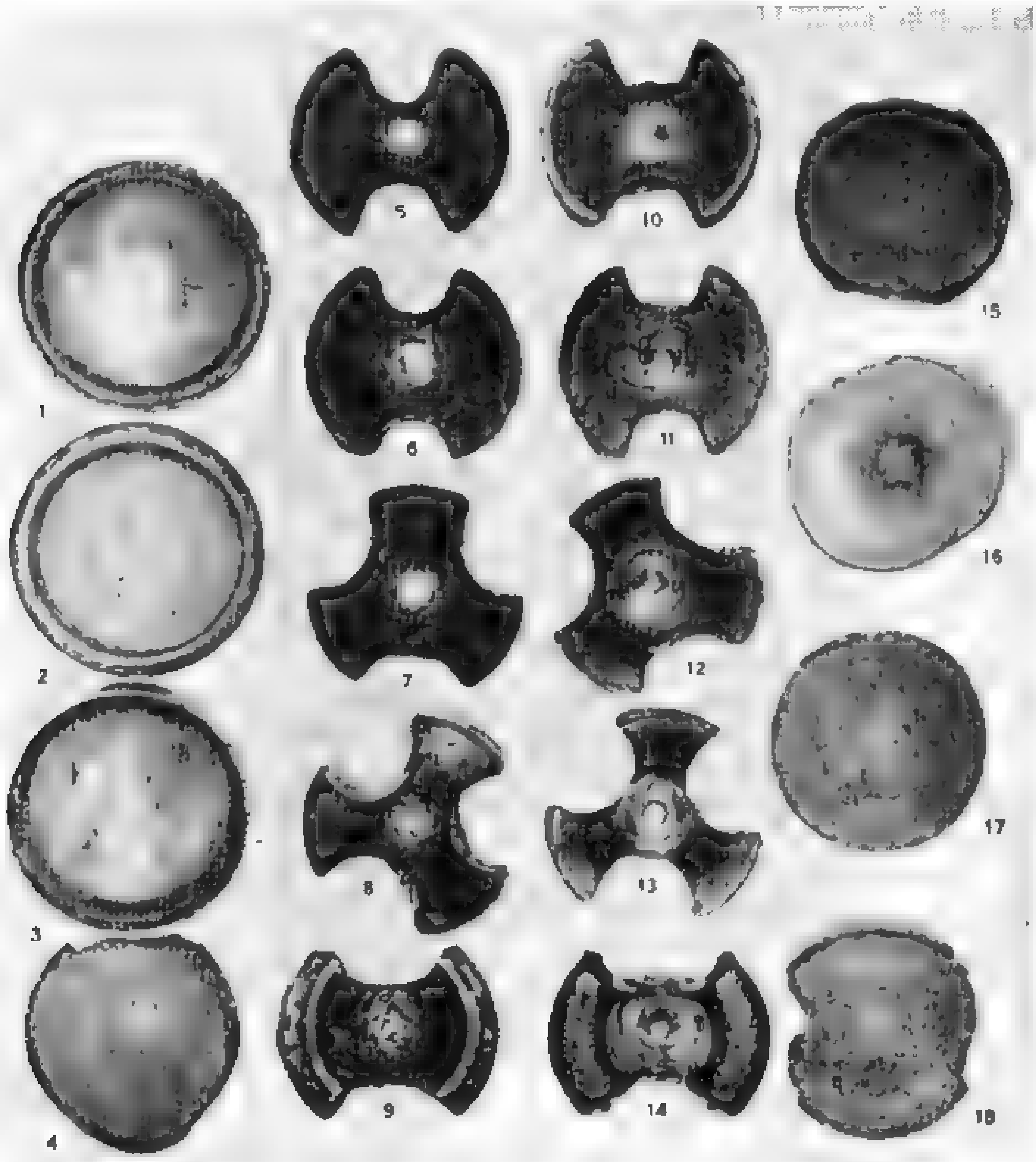
That scientific marvel was made possible through the development of a priming composition more than a century earlier!

Although primers are manufactured by millions each day and handled by all of us, we no more think of danger than if they were ordinary matches. The process of blending the various components has, from the time of its discovery down to the present date, been so fraught with possibilities of danger and distrust of workers, that kings have had to step in and regulate its formula and manufacturing methods, ordering that but one man at a time be permitted to preside over the "devil-mixture" which was likely at any moment to blow him into eternity. The mixture is more dangerous than an equal amount of dynamite or nitroglycerine.

It dates back to the research and invention of the Rev. Alexander John Forsyth (1768-1843) who in 1805 developed the mixture which made obsolete the old flintlock gun and created the era of, first, percussion ignition and, later, metallic cartridges. In 1930, some eighty-seven years after Forsyth's death, a bronze memorial tablet was placed on the walls of the historic Tower of London, the only memorial in honor of any *individual* ever erected within the precincts of that 850-year-old structure. . . . Forsyth did not invent the percussion cap. He made it possible by discovering that certain explosive compounds, even at that time prominently known, could be detonated by a blow *and so used to ignite the powder charge of a gun.* In 1805 he successfully adopted fulminate of mercury. The explosive mixtures of fulminate of mercury, silver, gold, and so forth, had previously been known with records dating back to 1663, but there had previously been no practical application of them. Forsyth called his 1805 mixture "detonating powder," and from that date on, he and numerous others designed and patented ingenious mechanisms for using it to ignite the powder in handguns, shoulder weapons, and cannon. It was so dangerous to make, however, that when His Majesty's government summoned Forsyth to the Tower of London to conduct official experiments and demonstrations, he was compelled to make his own mixtures, as officials would not permit their chemists to handle the dangerous concoction.

Although the flintlock had held absolute sway for two hundred years, the first twenty-five years after Forsyth's invention saw countless firearms makers and inventors everywhere appropriate his idea without legally encroaching on his patent rights. The primer was first used in the form of small pellets or powders, and various locks were designed to handle these. So numerous were the

inventions, indeed, that the records even of the most reliable historians are far from being complete on the subject. It is known, however, that hind the bullet, and were exploded through a sharp blow of the famous needle striker which penetrated through the powder charge to detonate the primer.



Microphotos by E. M. Chamot

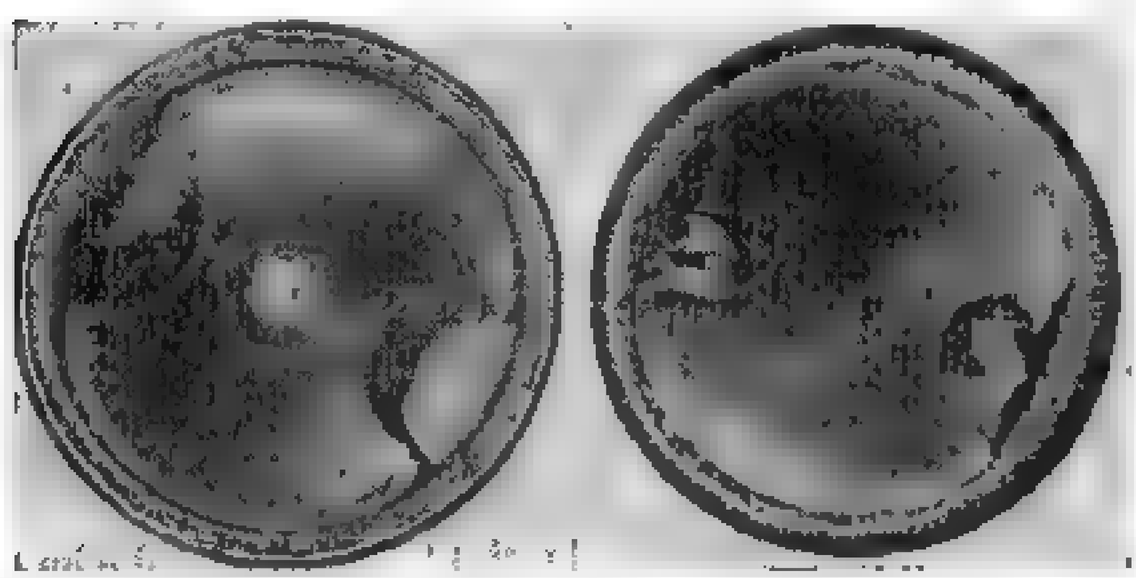
Difference in primer caps from the same lot. Note thick, thin and medium cup drawings. (4) The primer pellet removed from the cup. When the anvil was removed from this primer the pellet dropped out loosely and adhered to the shellacked paper discs. (5 to 14) Different American anvils. (5 to 9) Typical anvils of various types from the top side. (10 to 14) The same anvils from the bottom (15 to 18) The waterproofing paper disc as removed from the primer. Some of these fit nicely. Others fit loosely, thus admitting oil if it should happen to be present. Keep oil away from primers

Dreyse, in 1824, made copper caps in Sommerda, Germany. Pauly, in Paris, made paper caps or discs containing fulminate previous to the copper cap era, although the date is uncertain. Dreyse, at Sommerda, used such caps in the Prussian "needle gun" and its paper-consuming cartridges. The caps were located in front of the powder and be-

These military muskets were first made as muzzle-loaders but in 1835 were changed to breech loading bolt action arms, of which Dreyse manufactured 300,000 up to the time of his death in 1867. For his invention of this gun, the pride of the Prussian Army for more than thirty years, the one-time journeyman received great financial recognition

from his government and was "ennobled," becoming Baron Von Dreyse.

The name Lefauchaux is also closely identified with primer history. This name, in the minds of technicians, recalls only the famous pinfire type of cartridge, yet between 1820 and 1871 Lefauchaux turned out rifles, shotguns, pistols and revolvers in all the successful improvements—first percussion, then rimfire, and finally pinfire and—toward the end—the modern primer-in-the-head centerfire cartridge. In England, the famous Joe Manton developed a lock which held the cap on the nose of the hammer and struck it down a wide conical touch-hole communicating with the chamber. In 1818, Manton developed a slender copper tube about the diameter of a match stick and half-an-inch long, said tube being filled with fulminate. This was laid lengthwise in a horizontal vent in the barrel where it was struck by the hammer, the explosion igniting the charge and usually blowing away the tube. Other copper-cap ideas occasionally necessitated the operator to scrape the mutilated cap from the nipple. The Manton idea was used in the famous Merrill guns, of which more than 14,500 were bought by the British Government during that period.



Microphotos by R. M. Chamot

Effect of careless seating of primers, and use of primers in wrong case or pocket. Left, Remington primer carelessly seated in Remington primer pocket, thus distorting anvil and crumpling charge. Notice how paper disc has buckled and the pellet mixture has broken beneath it. Right: Remington primer seated in Winchester primer pocket. Note crimping effect of Winchester pocket on this primer. Distortion of the pellet and paper disc is certain to result in faulty ignition

In 1823, the American physician, Dr. Samuel Guthrie, hit upon the unique idea of rolling the fulminate into little pills or pellets which were dropped into a cup on the lock, where they were struck by the hammer, transmitting the flash through the tube or nipple to the charge. For several years these were widely manufactured, and many government and sporting arms were constructed to use them. These pills, although originated in this country by Guthrie, were introduced by an unknown inventor in England, and in 1821 Westley Richards produced high-grade arms with a lock capable of using *all* the new forms of ignition, such as loose detonating powder, paper caps or pills. Arms using pills were made as late as 1851, of which the curious and now rare Porter wheel-chamber repeating rifles and revolvers are an example.

The Percussion Cap. Who, therefore, invented the percussion cap? Great Britain heads the list with claimants as follows: Hawker, Manton, Durrs Egg (one of the eleven of the Egg family of gunsmiths between 1750 and 1880), Roantree, Lancaster, Lang and Westley Richards. France and Switzerland claim it for the Swiss Parisian, Captain Pauly, and for Baron Heurteloupe. Belgium and Germany also have long lists.

In 1825, in the fifth edition of his *Instructions to Young Sportsmen,* Captain Peter Hawker, the famous British sportsman, naïvely comments that he "does not say" that he "was the inventor of the copper cap," but only that in 1818 the idea of a "perforated nipple" and detonating powder in the crown of a small cap occurred to him, and he thereupon suggested it to Joe Manton, who made such caps. Note the date. This was at least four years after such caps were already in use in America. Even Greener of England gives credit to the United States for this development and takes his hat off to Joshua Shaw, a British-born but Americanized artist and sportsman.

Joshua Shaw was born in Belingeborough, Lincolnshire, in 1776, and in 1814 settled in Bordentown, New Jersey, soon removing to Philadelphia, where he lived until his death in 1860. He made his name as an artist before coming to America. The best account of his invention states that Shaw first had the copper-cap idea before he left England but kept his discovery secret until he arrived in America. (See "Origin of Breech-Loading Firearms," by Capt. Philip Reed, 3rd Infantry, U.S.V., published in *The Army Magazine,* Chicago, April 1894.) Soon after arriving in the United States he applied for a patent, which was refused him on the ground of his being an alien; the law at that time denying a patent to aliens unless they had resided two years in this country. This was Shaw's own statement. In 1814 he made percussion caps with steel cups, changing to pewter in 1815 and to copper in 1816. England copied some of his caps as late as 1820 by using thin tinned iron. In 1822 he patented a lock action to use his caps.

Shaw had used potassium chlorate, but, as he wrote, this was "too sensitive and liable to acci-

dental explosions," and so a mixture of fulminate of mercury, chlorate of potash and powdered glass was finally employed. In 1846, at the age of seventy years, on special recommendation of the Government's Congressional Committee of Patents, Shaw was awarded an honorarium of $25,000 for his discovery and improvements. It is a matter of record that petty politicians stepped in and effected a reduction of this sum to $17,000.

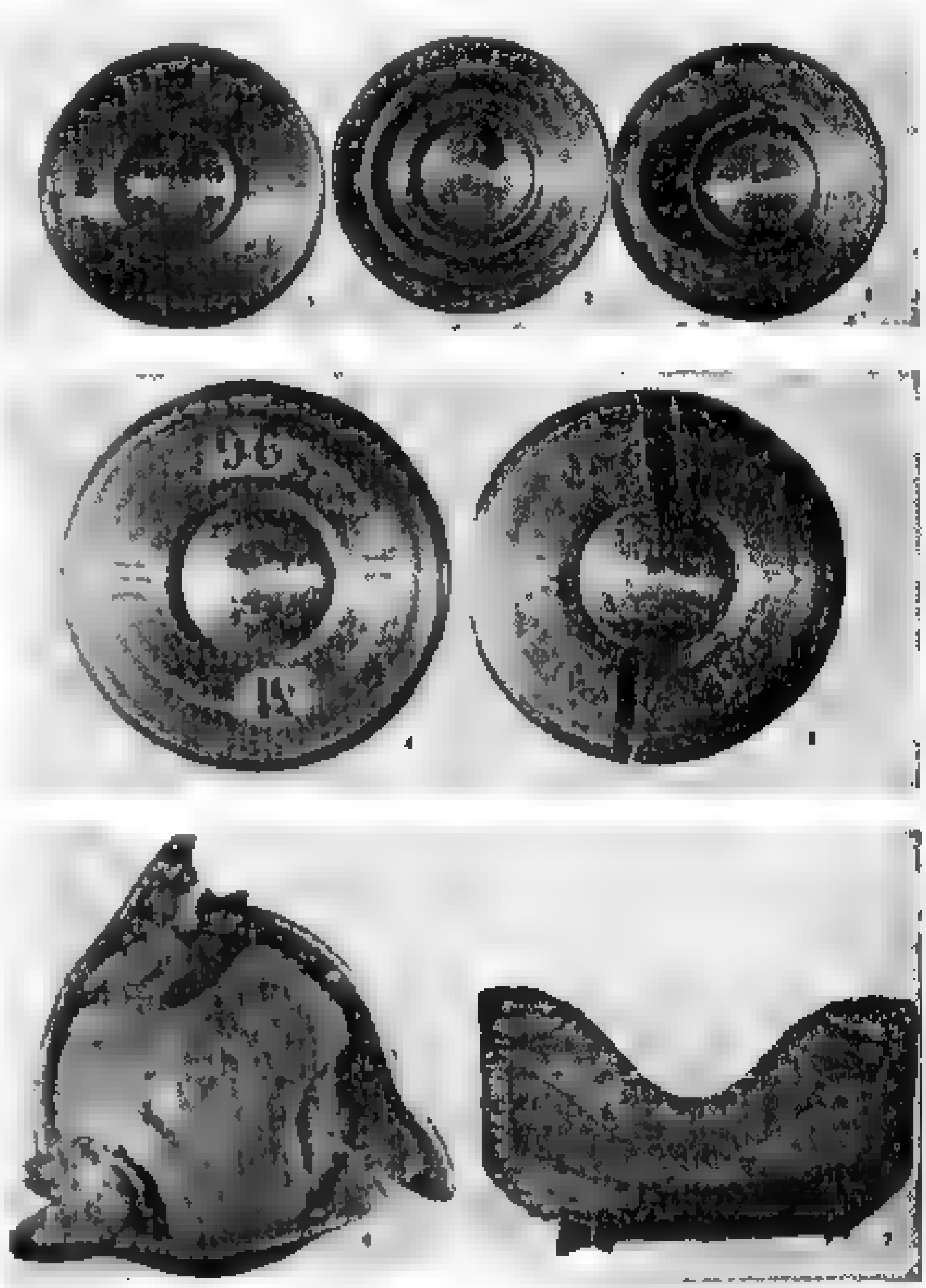
In 1828, Charles Eley, who founded the famous British ammunition firm of this name, was blown to pieces in handling priming composition in his shop. Shortly thereafter the British Government stepped in and regulated by law both the method of manufacture and the formula to eliminate accidents.

In the United States, between 1812 and 1825, seventy-two patents were issued to American inventors for various forms of primers. The Maynard tape primer described in Chapter III was one of the most satisfactory of the entire line, although it came out during a time when the copper cap was thoroughly established. The famous Sharps rifles were made from 1848 to 1852 with a Maynard primer magazine on both military and hunting weapons. In 1855 the British Government contracted with Christian Sharps for 6500 .52-caliber carbines designed for the Sharps linen cartridge with Maynard tape primer magazines. This despite the fact that the Sharps arms were, from the first, put out in the common nipple-and-cap ignition system. Chapter III gives still further information on these developments. Percussion caps were in such demand throughout the Civil War, that Southern spies were sent into the North and instructed to obtain, at any price, large quantities of caps which they secreted on their persons and smuggled back into the Confederacy.

Even today laws regulate the manufacture of primers in some countries. The latest (1929) edition of the *British Textbook of Small Arms*, on pages 233 to 235, gives a digest of the formula and manufacturing methods established by law.

Some day a worthy historian will record the true facts of the primer, and in doing so he will write an entire book on the subject. Nothing short of a full volume would do this tremendous subject full justice.

The Centerfire Cartridge. With the modern centerfire cartridge came the true beginning of the handloading era. All manufacturers of ammunition sold not only factory loads but also all components from cartridge cases to primers and bullets. The cartridge case was at that time of folded head construction, although the solid-head type followed along shortly thereafter. In addition, the Ideal Manufacturing Company brought out a line of "Everlasting" shells which were not only made in solid head but also of much sturdier brass. With standard .38/55 empty cases selling at about $1.80



Microphotos by E. M. Chamot

Method of removing primers from cartridge cases where it is desired to analyze them for photographs. Punching the primers out would mutilate the pellet. Shell is chucked in a lathe and the head turned off as in figures 2 and 3 so the primers can be picked out with the fingers. The method used on such shells as figure 4 of the old folded-head type is to saw through the head as illustrated in figure 5. Anvils are removed by means of special cutters as in figure 6. This is extremely dangerous without proper equipment, and must not be attempted by a handloader. Figure 7 shows a primer which has been sawed in half. These and other microphotos in this chapter were taken by Professor E. M. Chamot of Cornell University

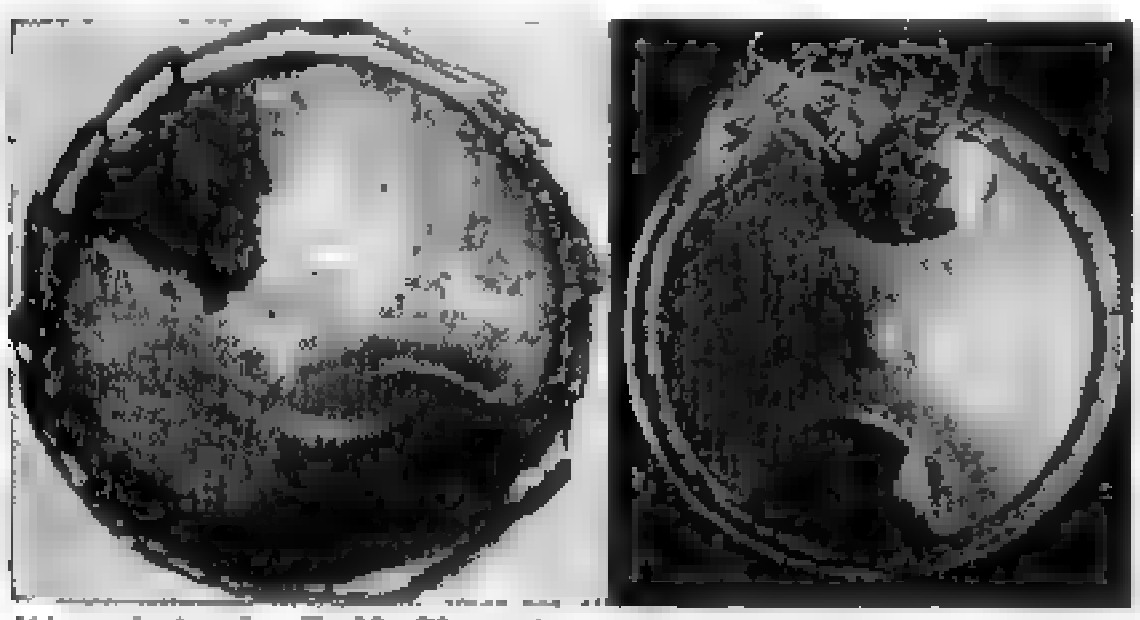
per hundred, the Ideal "Everlasting" cases were priced at six cents each—three times as much. They did have a great deal longer life and were much in demand by reloaders. "Everlasting" shells, because of their stiff brass and thicker walls, did not hold as great a charge of powder and could not be crimped, the latter point eliminating them from practical use in repeating rifles.

And so we get to the period of the 1890's. Up to this time, metallic ammunition and handloading

had, generally speaking, meant exclusive use of black powder; therefore the primers had been a fulminate-of-mercury cap designed to ignite black powder efficiently. In the early 90's, when smokeless powder entered the scene, ignition troubles were immediately noticed, as the black-powder primer was insufficiently "hot" to ignite the new propellent. Accordingly, ammunition manufacturers set to work on the problem and designed a primer sufficiently strong to ignite the smokeless. They still manufactured the black-powder primer, which was widely sold up to about the time of the World War, despite the fact that the smokeless primer performed as efficiently with black powder as the old primer. Smokeless primers immediately brought forth a great many problems which hitherto had gone unnoticed among the handloading clan.

Microphotos by E. M. Chamot

Perfect example of what careless primer seating can do. Primer on the left was slammed home in a slipshod manner. Note the distortion of the anvil. On the right is seen the same primer with paper disc and anvil removed. Notice how the primer pellet is broken up. This primer would give extremely faulty ignition, possibly a misfire or hangfire

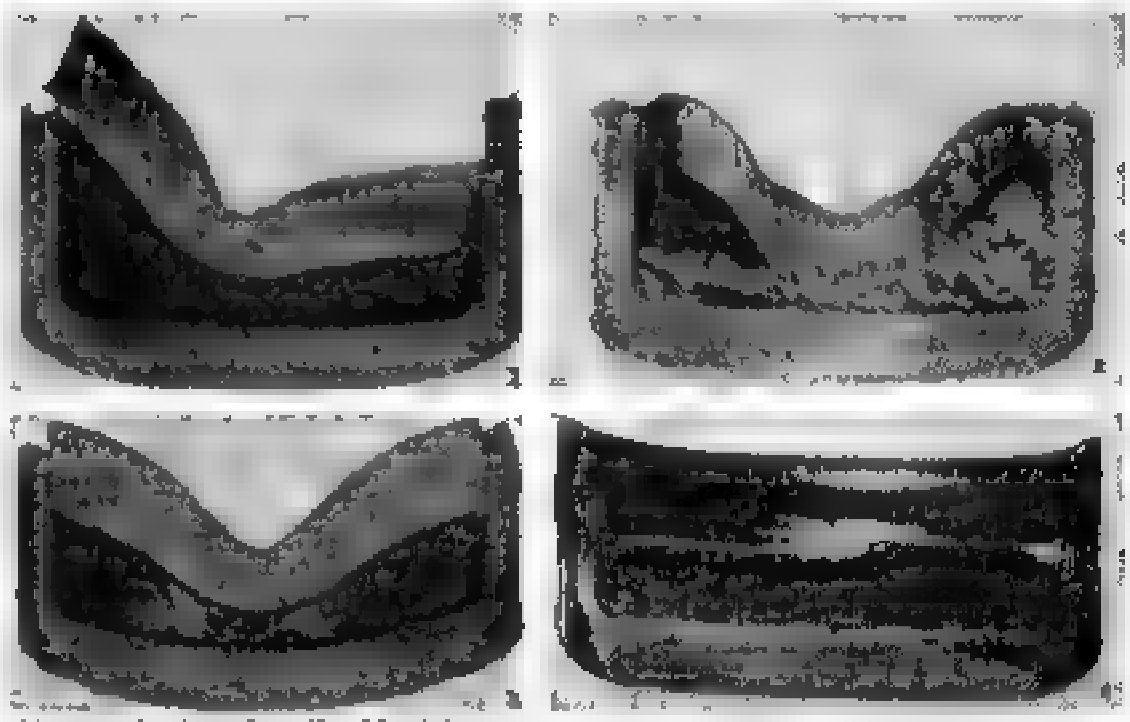


Microphotos by E. M. Chamot

Inspect your primers carefully. At the left is a primer which has been discharged but failed to burn up the paper disc. On the right is a primer just as it was removed from the box. Note the very fine excelsior crimped between the anvil and the primer cup. Inspectors don't always catch these flaws. It will do you no harm to inspect primers for match ammunition beneath a magnifying glass

Magazines and catalogs of about the 1900 period waxed loud in their discussions of the good and bad points of various smokeless powders and the problems created by their use. By 1905 there were two distinct types of smokeless powder available to handloaders—the bulk and the dense. The former was known as low-pressure; the dense powders were classed as high-pressure. In the former we had such powders as Du Pont #1 and #2 rifle, Bulk Shotgun, Oriental, King Smokeless, #1, #2, #3 and #4, E. C., Schultz, and so forth.

In the same dense-powder family was the Laflin & Rand, Lightning, Sharpshooter, Unique, Infallible, W.A., Du Pont .30-Caliber Annular Government, and so forth, in the Du Pont tribe, and a number of German importations widely sold on the American market. Both types were occasionally used by handloaders with black-powder primers, when a small priming charge of black powder was first inserted into the bottom of the shell.

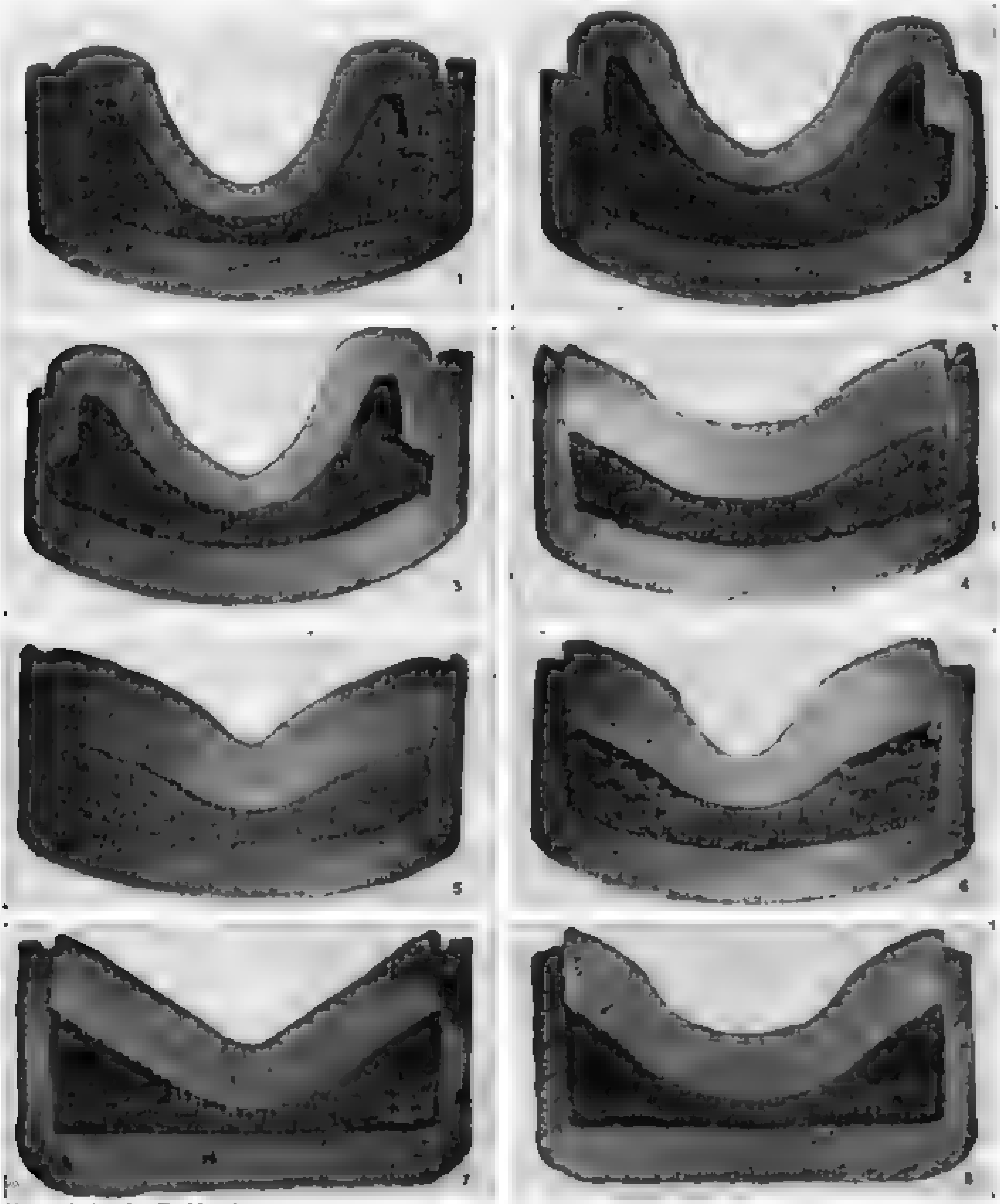


Microphotos by E. M. Chamot

Cross-sections of live primers. Figure 1 shows a tipped anvil. Inspection would disclose this. Do not attempt to use it. Figure 2, extremely irregular poor-quality priming mixture, not properly distributed through the cup. Figure 3, cross-sections of a primer which started to decompose. This was located in examining a batch of defective primers. Note cloudy white color of priming mixture below anvil. Figure 4, a Berdan primer, cross-section. Note that primer pellet is slightly compressed in the cup. Disc of tinfoil over the pellet may be seen

Primers available in 1900 included the UMC #"O," adapted to UMC shells only; and the UMC #1, 1½, 6, 6½ and the corresponding sizes in Winchester to fit the same pockets bearing the numbers 1, 1W, 1½, 1½W; UMC primers #2, #2½, #7, #7½ would interchange with Winchester #2, #2½W and #3. UMC primer #8½ was also the same size as Winchester #5. The Berdan-type primer was also sold (still available on special order). These were made by both UMC and Winchester bearing numbers 1, 1½ and 2; #1 only for sporting and military cartridges; #1½ for brass shot shells and #2 used for small rifle and handgun

cartridges. Winchester and UMC #1 were both black-powder copper-cup primers adapted to the low pressure rifle cartridges running from .22 WCF up to .45-70; the #1½ UMC and #1W Winchester were adapted to the similar line of cartridges, but for smokeless powders, and were made of brass drawn to a heavier cup than the black powder load. Number 1½ Winchester was the same size as #1 Winchester but designed for black powder revolver cartridges, while #1½W, also a copper primer, was designed for smokeless powders. List price on primers in 1900 was $1.70

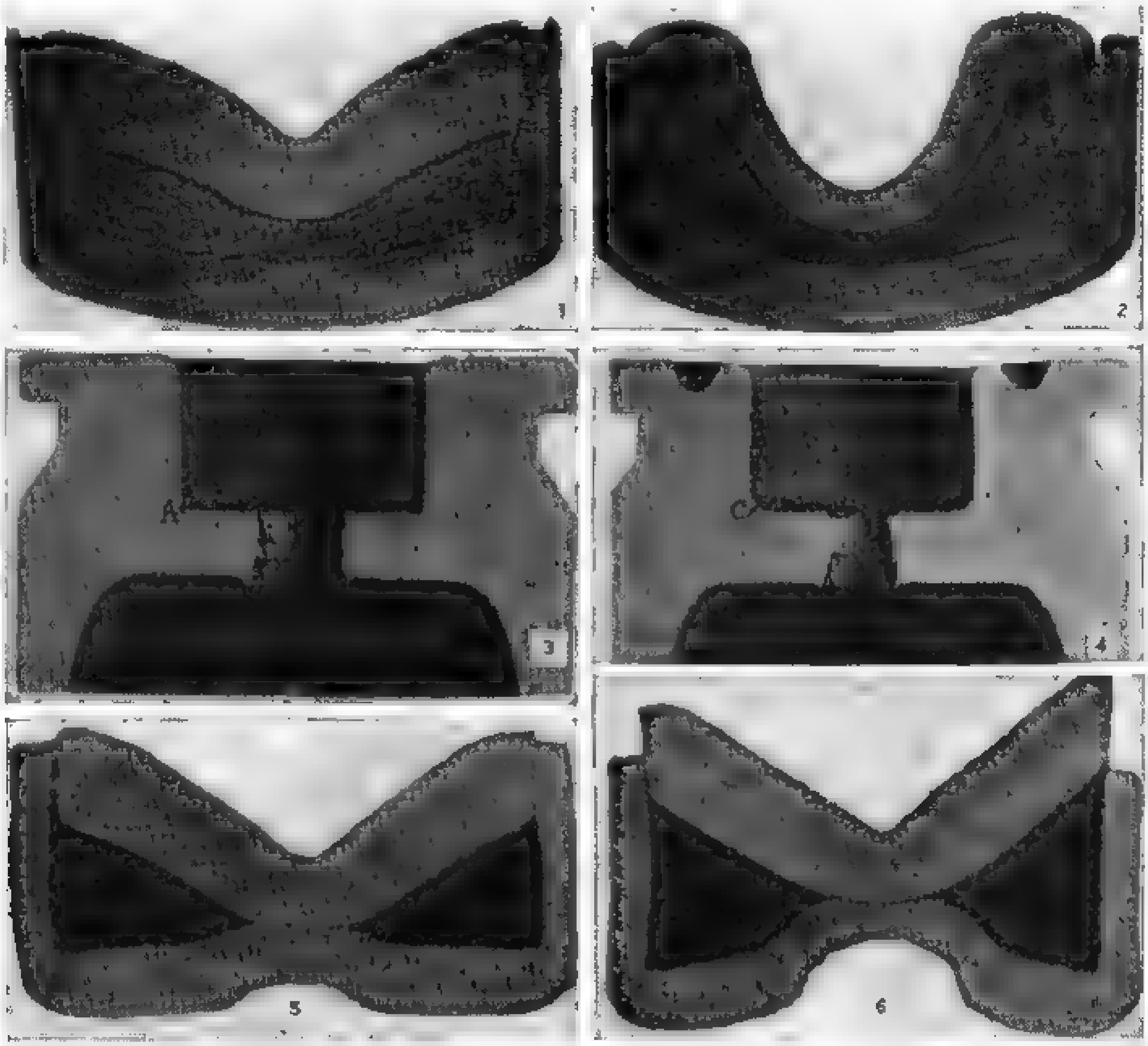


Microphotos by E. M. Chamot

More primer abnormalities. These illustrations also show clearly the difference between Remington and Winchester types of construction. Figures 1, 2, 3 are Winchester products in which the primer is seated on the anvil at the bottom of the primer pocket. The others are of Remington type, in which the primer is supposed to seat on the mouth of the cup rather than on the anvil itself. In figure 1 note cocked angle. In figure 2 note uneven sides to the cup. In figure 3 one side of the cup is much bigger than the other. Figure 4 shows a slightly cocked angle. Figure 5, a normal primer. Figure 6, poor quality of pellet improperly inserted and anvil improperly punched and projecting too far out of cup, thus primer is quite likely to explode when being seated. Figure 7, insufficient and poor quality of pellet. Figure 8, improperly shaped anvil projecting too far out of case, coupled with insufficient and poor quality of pellet

per thousand for the Berdan type and $2.00 per thousand for all others.

Smokeless Powder Problems. In the late 1890's, some of the ammunition makers who had for years sold components to reloaders and advocated reloading, began to publish notes on their smokeless powder shell boxes, saying: "These shells cannot be reloaded." At about this time, Winchester released a circular entitled, "Reloading Smokeless Powder Cartridges Impracticable." The chief remark of importance in these circulars, as we look back at them, was just this: "All smokeless powders are injurious to brass shells. . . . Experiment shows that after the first firing with smokeless powder, the metal of the shell undergoes a slow but decided change, the exact nature of which the best experts have as yet failed to determine. No immediate deterioration attends the using of smokeless powder. . . . If fired shells are allowed to set two or three days, clean or unclean, wet or dry, loaded or unloaded . . . the metal becomes brittle and rupture of the shells at the next discharge is probable. Various proportions and kinds of material used in the manufacture of the brass have been tried. . . . Chemists have examined shells before and after firing to determine the exact corrosive effect of the gases. . . . Experiments show that these problems are characteristic of *all* smokeless powders and are in no way due to the material used in the shells, the process of manufacture or the kind of gun used. . . ." This circular continues to quote reports of tests made at Frankford Arsenal in 1896, said reports being still available to the curious handloader in the reports of the Chief of Ordnance for that year

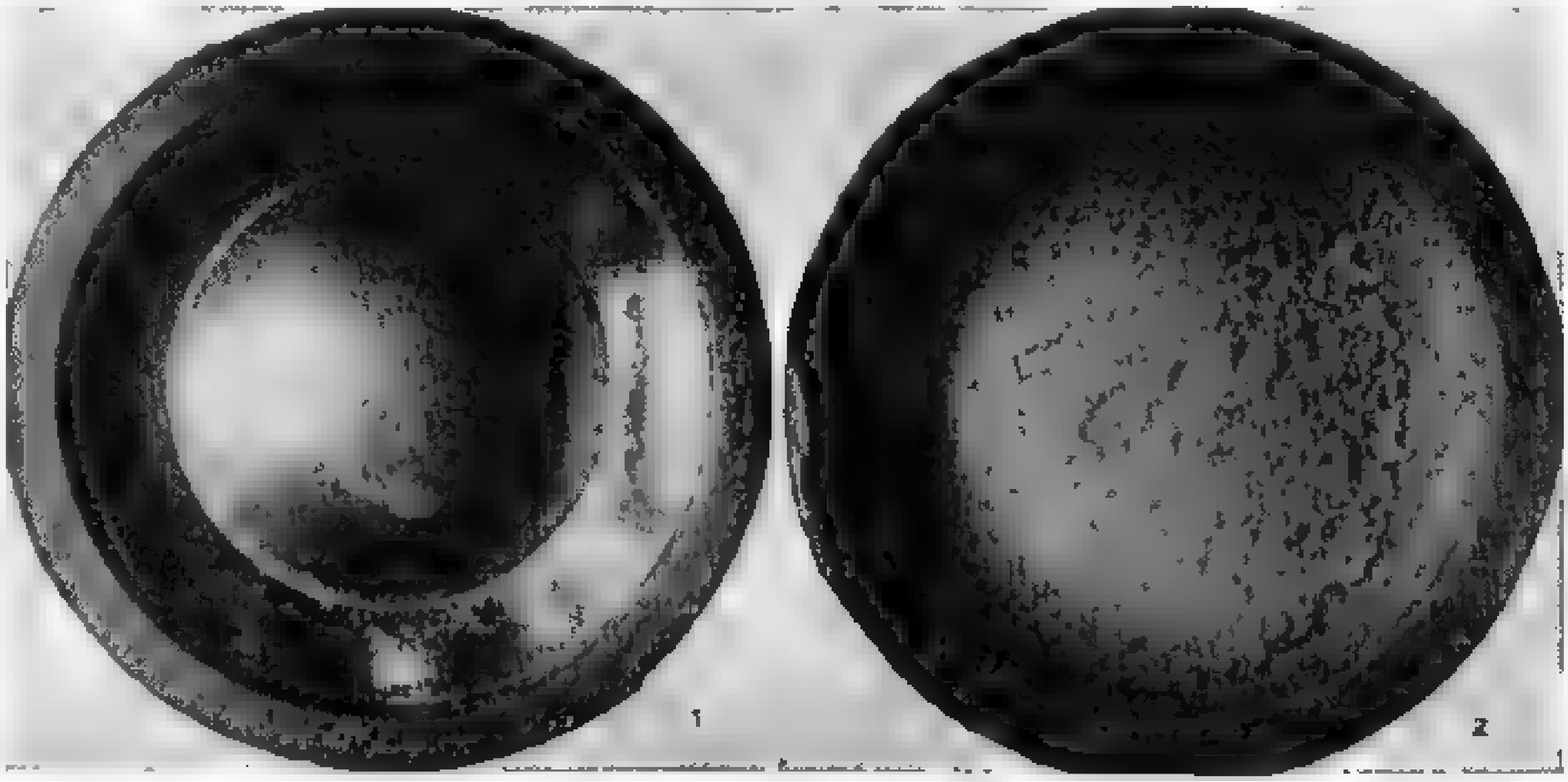


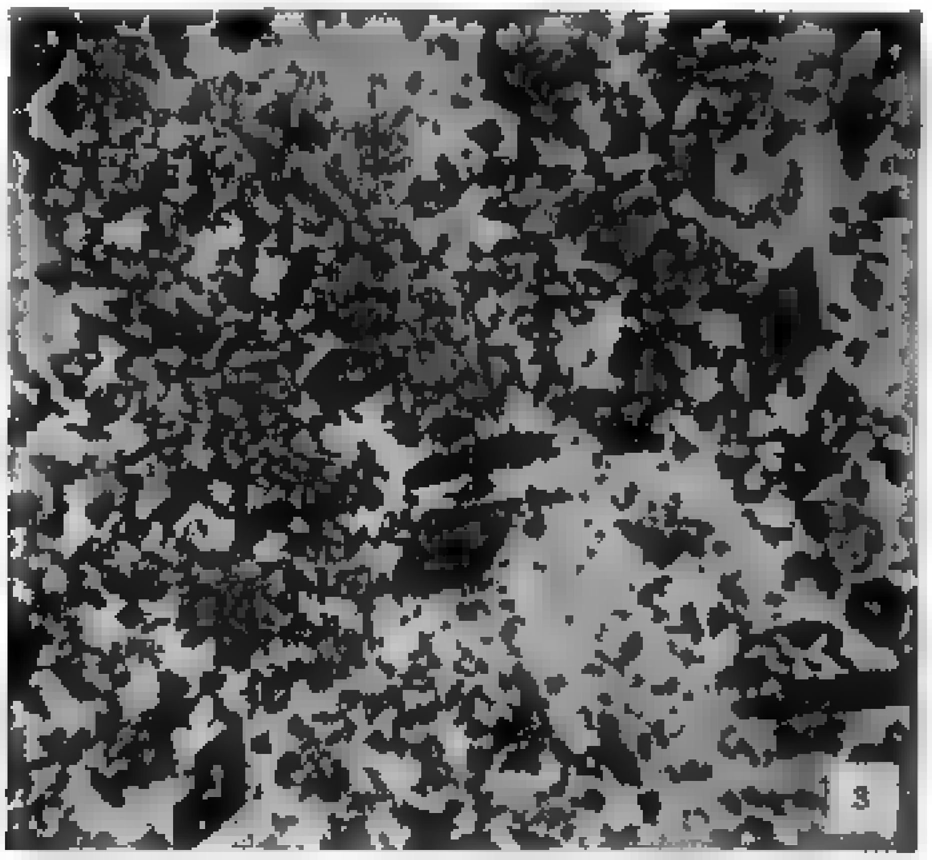
Microphotos by E. M. Chamot

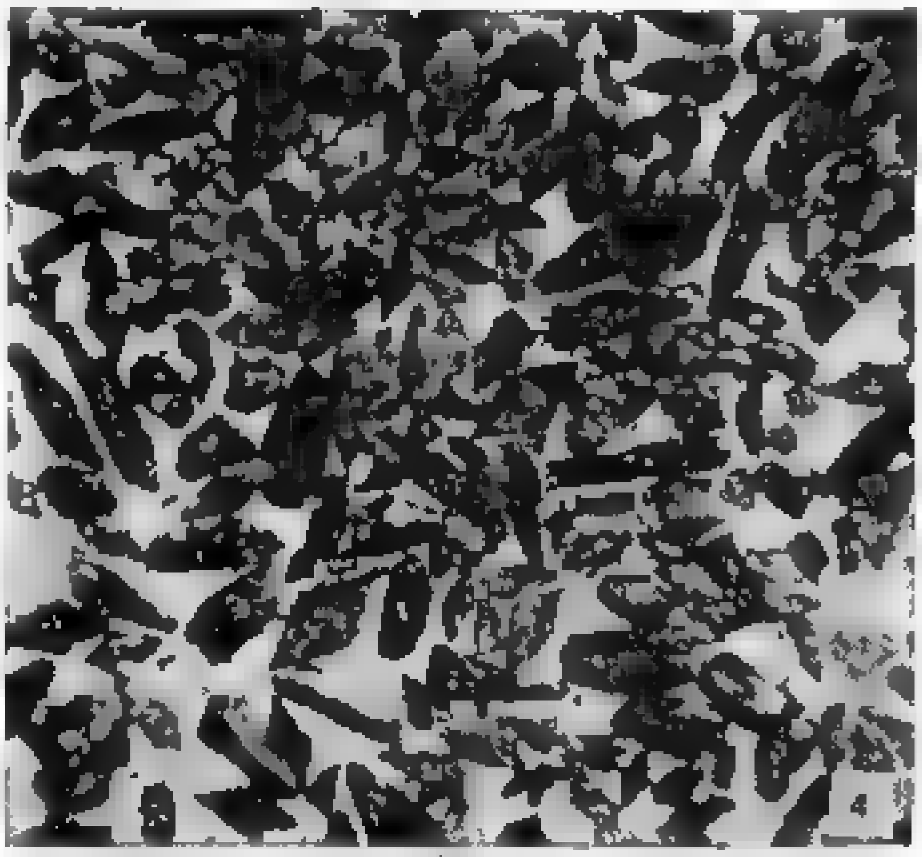
Fitting primers to pockets. Figure 1 shows a normal Remington primer Figure 2, a Winchester primer with anvil slightly cocked. Figure 3 shows a Remington shell head and cross-section. Figure 4 is one of Winchester's make. Incidentally, in this particular shell the primer was crimped and one may see the crimping groove. Note the difference in primer-pocket shapes at A and C. Figure 5, a Remington primer fired in a Remington primer pocket. Figure 6, Remington primer fired in Winchester pocket

And yet the annual report of the Chief of Ordnance for the year ended June 30, 1897, *solves the problem well.* An extract from page 26 runs as

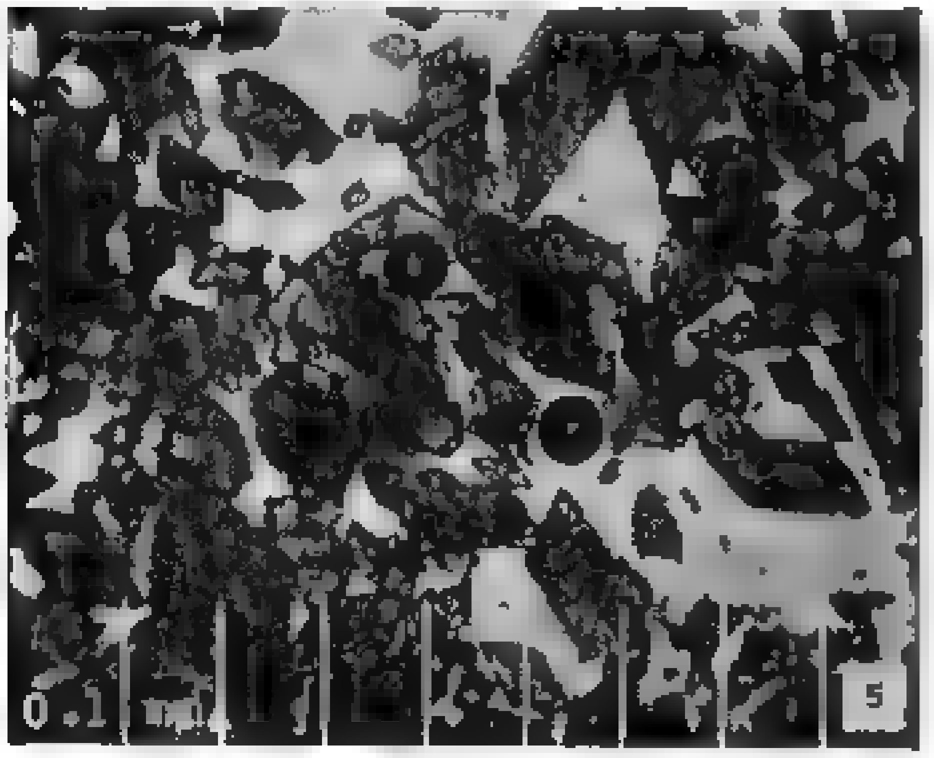
follows: "The principal cause of brittleness in the present shell, which is made of brass composed of 70 copper and 30 zinc, has been traced to the action of mercury in the primer in conjunction, possibly, with the use of an alloy of copper for the metal case containing a reduced percentage of zinc."







Microphotos by E. M. Chamot



Berdan type of primer showing foil disc. Figure 2, same primer with disc removed. Figures 3, 4 and 5, primer pellet mixtures as seen through the microscope. Note difference in those of various makes. Figure 5 is a mercuric primer. Notice tiny globules of free mercury in the mixture as evidenced by the round dots

of the *mercury in the primer composition* reacting on the metal of the case, particularly on the zinc. . . . At a distant stage of the investigation it is expected that a serviceable reloadable cartridge will be produced by reducing the amount of fulminate

In running down this extremely important problem, J. M. Barlow of Ideal wrote various manufacturers. Under date of March 22, 1898, Du Pont wrote that all primers contained fulminate of mercury, and that the larger amount necessary to ignite

smokeless powders created the brittle cartridge-case problem, but that since smokeless #1 and #2 ignited fairly well with black-powder primers, they had much less trouble than when using the new .30-caliber high pressure loads.

The King Powder Company, on March 18, 1898, practically supported the Du Pont statement with a similar letter, pointing out that their bulk powders had given very little trouble with the split-case problem.

The Marlin Firearms Company also came through with remarks on a particular test which ended after seventeen reloads.

UMC cases were used with #6½ UMC smokeless primers; six shells being tested with Du Pont .30-caliber military and the other six with King's #1, Smokeless. After seventeen reloads, only two of the shells loaded with dense powder survived, while five remained from the King series.

The Laflin & Rand Powder Company reported that while damage to shells had been found in the small bores such as 6 mm. Lee, 7 mm., .30/40 Krag, .25/35, .25/36, and .30/30, they had found no damage with big-bore .45/70 cases; they reported a group of .45/70/500 shells loaded with smokeless powder, which they had reloaded more than fifty times without a single failure. The shells were not cleaned during the test. They also mentioned that Dr. A. A. Stillman of Syracuse, N. Y., had used one .32 Ideal necked down to a .28 caliber more than 175 times before it finally split lengthwise. Smokeless powder was used for all loads.

The general run of opinion, however, clearly indicates that smokeless powder and smokeless-powder primers were extremely tough on shells. Today we know the answer, as it was suspected by the Ordnance Department in 1897: The mixture developed by Alexander John Forsyth was poisonous to brass, particularly when smokeless powders were used.

Why with smokeless powders? The old-time writers neglected to point out a very significant fact. Black powder left a very serious residue, not only in the bore of the gun but also in the brass case. Riflemen soon learned that it was necessary to clean their brass cases to prevent corrosion. This black-powder fouling absorbs a large quantity of the free mercury released by the act of firing, thus negating the effect on brass. Smokeless powders left no such residue and therefore did not coat the brass with a heavy protective covering. They also burned at a higher pressure. Certain ballistic engineers to the contrary notwithstanding, the effect of a mercuric primer on a brass cartridge case *is in direct proportion to the pressure within the case at the time of firing.*

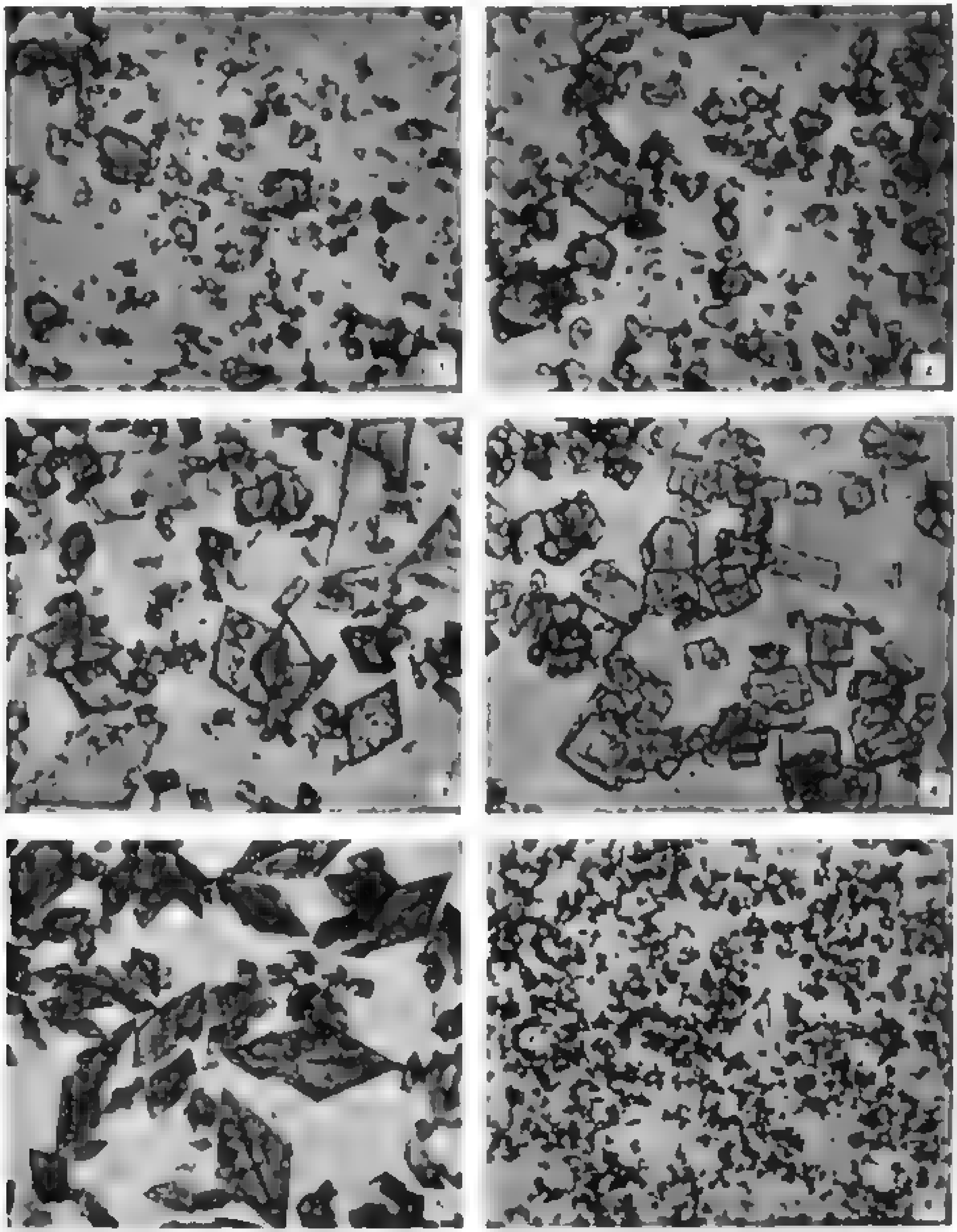
Early Primers. The problem of early-day primer manufacture did not necessarily mean the manufacture of a certain composition to ignite powder. It had to consider the working pressure and the guns to handle them. Early primers were made of copper, since they were designed for black-powder cartridges operating at a pressure of ten thousand pounds or lower. A soft copper cup was very necessary, since many of the early guns had weak hammers or firing-pin blows. Early repeating weapons were great offenders in this. If the primer cup was too hard, it would fail to dent sufficiently to permit discharge under impact of the firing pin.

The two sizes of primers designed in the early days for rifle and handgun cartridges were very similar to the two sizes in use today. Their diameters run about .175 and .210 to accommodate various cartridges. A slight change was made in all these primers, but it ran to length, with corresponding primer-pocket depth, more than to diameter. This is true even today. Generally speaking, the early handgun and rifle primers differed chiefly in material of the primer cup and its corresponding hardness, much as they do today.

The UMC #6 primer was one of the first to be made for the so-called "sporting and military" sizes appearing in the early 1890's. It did not work so well in the Krag cartridge, but was all right for such cartridges as the .30/30 and the UMC #8, which was also made of copper. This UMC #8 proved to be sufficiently strong for high-pressure loads, although the UMC #8½, practically the same primer in a brass cup, proved to be more popular for the .30/40, 6-mm. Lee, and similar sizes.

The first really successful smokeless-powder primer was the famous government primer "H-48," designed at the Frankford Arsenal for use in the .30/40 Krag cartridge. This primer appeared around 1898 and was the standard government primer for many years. It was similar to the UMC #8½ except that it had a non-mercuric priming mixture and was widely copied by commercial ammunition makers almost from its introduction. A few boxes of sealed Winchester and UMC shells loaded commercially in 1901 were primed with a non-mercuric mixture, quite possibly the H-48. Two groups of these 1901 Winchester loadings are in the author's collection one of them powered with Peyton (picric acid) powder manufactured by the California Powder Works, and the other with Du Pont .30-caliber An-

nular Smokeless. The latter used a brass cup, while the former has the steel cup containing a thin copper inner cup to hold the mixture. These cups in Berdan primers manufactured by the Western Cartridge Company for use in the French Lebel cartridge but here the idea was to stiffen the cup



Microphotos by E. M. Chamot

Components of primers as seen under the microscope. Figures 1 and 2, potassium chlorate. Note variation in grain size. Figure 3, tetryl (Trinitrophenylmethylnitramine). Figure 4, T.N.T. Figure 5, fulminate of mercury. Figure 6, lead thiocyanate. All photos same magnification.

primarily were swaged together before the insertion of the priming mixture and the job was so well done that we discovered it only when dissecting primers for a chemical test in the laboratory. The double cup idea was used during the World War and prevent accidental discharge through contact of the pointed bullet ahead in the tubular magazine of that rifle. It will be seen, therefore, that the double cup idea was not new—it had been tried at least fifteen years earlier.

Non-mercuric primers became items of importance to all ammunition makers at the turn of the century. A box of UMC 7-mm. cartridges loaded in 1900 used a primer which laboratory tests very clearly show to be non-mercuric. The idea apparently spread early and Frankford Arsenal developed its now famous #70 mixture in a non-mercuric and improved on the H-48 mixture. This primer, introduced in September 1919, is the accepted formula used at Frankford Arsenal today, since the Armory has not found a non-corrosive mixture with the necessary characteristics of reliability, life in storage and similar features required of military ammunition components.

The handloader today should watch his primers extremely carefully regardless of the type of gun they have been shot in. If they flatten too badly, regardless of the pressures of the load in question, he should either tone down the load or discard it entirely, as the primer, if it becomes pierced, will pour gas back through the mechanism in the direction of the shooter's eye. This is particularly true of old types of gun actions such as Ballard, Stevens and Winchester single shots, in which the primers are only two or three inches from the shooter's eye during the process of shooting. He should watch for too large firing-pin holes in the breech face or sharp-pointed firing pins which might puncture his primers. This is true even of bolt-action guns, in which the primer is three or four inches farther from the eye.

A good caution worth mentioning here is the recommendation that the handloader wear a pair of shooting glasses. A pierced or punctured primer may spit gas into the face and slightly scorch the cheek if glasses are worn, but it cannot damage the eyesight. Years ago, we had a punctured primer in a Winchester 54 and the resulting spit of hot gas into the face showed the author the importance of using shooting glasses at all times. It is better to be safe than sorry.

Primer Manufacture. How are primers manufactured? The Peters Cartridge Company have listed a full seventeen distinctive steps in their manufacturing methods. Primers, like cartridge cases, begin life as sheet metal, either brass or copper, according to specifications. They are first cut; then given a washing and cleaning; third, drawn to shape; fourth, assembled into steel plates, the drawings dropping into small pockets, cup side upright to receive the priming mixture. The fifth operation includes the charging of an entire perforated steel plate with wet priming mixture. This highly explosive dough is dropped on the steel plate very gently, and the operator, by means of a rubber squeegee, wipes it over the plate, completely filling the tiny pockets, each of which constitutes an individual primer charge. This plate is dropped into position over another plate containing the empty cups, and by means of a special punch arrangement the pellets are pressed through the plate into the waiting copper cups. The plates are then fed into a machine and the wet mixture packed into position, whereupon they are set aside for inspection.

After feminine operators weed out cups which appear to have an irregular amount of priming mixture, the approved cups go back into a machine which punches out a small disc of shellacked or waterproofed paper, inserts it over the primer mixture, and cements it in position with a tiny drop of shellac or varnish. The primers then appear like the Berdan style (without anvils), and are again inspected.

Anvils also begin life as sheet metal, the initial process being known as blanking and consisting of punching out sheet metal to the proper size and shape of anvil, so that a single operation completes the job. Anvils are then washed and dried to free them of oil, grease and débris. The primers, still charged into pockets of the plates, are now ready for the anvils. These are similarly charged into plates which are placed over the plates holding the primer cups. Anvils fit into a special plate in such a way that upside-down anvils in a properly operated factory are really a thing of the past, although mistakes occasionally occur. The two plates are placed together with the anvils on top and inserted into a special multiple punch press, the operation of a lever forcing the anvil from the assembling plate into the primer cups, whereupon the primers are completed and ready for the final inspection. Up to this time the priming mixture must be kept moist, otherwise serious explosions might occur. After being dried in special ovens the primers are ready for ballistic tests.

All through the manufacture of primers, there is a rigid series of inspections, and the priming department is one from which visitors are usually barred. It is the one dangerous department in modern ammunition manufacture. Even today accidents occur occasionally. It has even been a practice of certain companies to pay an increasing weekly bonus to employees of the priming department if there has been no injurious accident or explosion within that department. The bonus increase ceases after reaching a certain point and remains at that figure until an accident occurs,

whereupon all employees of that department go back to their former salaries. This system has helped to reduce accidents.

The above description of primer manufacture is only approximate. While this system is used in some factories and for some sizes and types, certain operations are varied in other factories. Modern machinery is rapidly reducing the so-called "plate methods" of charging primers and seating anvils and some of these operations are now strictly automatic with modern machinery. The system of inspection between stages, however, always has remained in force and probably always will, since the primer is the heart of the cartridge and a defective primer at a wrong time will totally cripple a gun and may cost the life of a hunter, soldier or law-enforcement officer, should a misfire occur at a critical moment.

VII

THE NON-CORROSIVE PRIMER

A GREAT many handloaders will recall the announcement less than ten years ago by Remington of the so-called "Kleanbore" primer—the "first" non-corrosive primer on the market. It is true that Remington introduced the non-corrosive primer into this country, that is, as far as the average shooter's conception of their popularity is concerned. On the other hand non-corrosive primers are by no means new and date back to a period before the World War.

Since the author had the privilege of gaining advance information on a visit to the Remington laboratories where the Kleanbore primer was developed, he became extremely interested in this subject. For many years he made a study of the formulas and practices throughout the world. It may be a wild guess, but it is quite possible that more than 100 formulas of non-corrosive primers have been patented throughout the world. Nearly one-half that number have been patented in the United States in the past twenty-five years.

In the assembling of data on primers, the author is greatly indebted to Professor Émile M. Chamot, of the Department of Chemistry of Cornell University. Professor Chamot is probably one of our greatest primer authorities of today. During the World War he was very active on behalf of the United States Government in developing numerous forms of tests of primers, and in this work has probably handled half a million of the little pellets merely in laboratory examination with the aid of his able corps of assistants.

To understand the action of the non-corrosive primer, one must first understand the performance of the old-style corrosive mixture. As previously stated, the old formulas are essentially of the non-mercuric type, a combination of potassium chlorate and antimony sulphide. When these two elements are mixed together they have a tendency to combine chemically under the influence of heat such as that produced by a blow or friction. The result of this chemical action is three separate chemical combinations—potassium chloride, antimony oxide and sulphur dioxide, the latter, of course, a gas. This is a highly explosive mixture—a gas generated at high temperature in an extremely short time. The temperature resulting from this reaction is about 3500° centigrade—nearly 6400° Fahrenheit.

Technically, this reaction, leaving out all the chemical symbols, is: Potassium chlorate plus antimony sulphide equals potassium chloride plus antimony oxide, plus sulphur dioxide. Similarly fulminate of mercury and potassium chlorate change into free mercury, nitrogen, potassium chloride and carbon dioxide. These combinations of chemicals with potassium chlorate omitted are by no means as sensitive as is desired for primer use. Accordingly it is necessary to add some form of abrasive such as powdered glass to produce the necessary friction to cause it to respond to a hammer blow. The so-called non-fulminate primers have the mercury fulminate replaced entirely by sulphur, lead or copper sulphocyanide with small additions of such substances as T.N.T. and tetryl.

In the non-corrosive types of primers the potassium chloride is replaced wholly or almost wholly by the barium peroxide, barium nitrate and lead peroxide. It has been definitely proved many times that potassium chlorate, which produces potassium chloride, is responsible for the rusting or corrosion of gun barrels. Thus the necessity for eliminating it from the formula.

The first practical non-rusting rimfire priming was the German .22 "R" cartridge which was very popular from 1910 to 1913. This cartridge was widely sold, not only on the Continent but in England. It was a smokeless cartridge and the powder did not give an alkaline residue, so the non-corrosive primer was a distinct advantage. The composition of the famous "R" priming was as follows: Mercury fulminate 55%, stibnite 11%, barium peroxide 27%, T.N.T. 7%.

Since this formula is very similar to those in use today, it is well to analyze it to determine exactly what happens. Barium peroxide gives up oxygen and becomes barium oxide. The latter combines with the carbon dioxide, also a product of combustion, and becomes barium carbonate. The latter is a hard, flinty substance. The fine particles form on the combustion and act as a very effective abrasive when the bullet travels down the bore. Thus, this particular type of priming mixture creates severe *erosion,* which is frequently far more serious than rusting or corrosion. Thus in the .22-caliber

line, the Lesmoke cartridge when introduced soon superseded the German "R" cartridge. Because of the Lesmoke powder, which gave an alkaline residue, the ordinary primer could be used, thus elimi-

Microphoto by E. M. Chamot

Hornet cartridge case which had been primed with a mercuric primer of the non-corrosive type (new case) and fired once. Head pulled off in resizing die. Note crystalline structure of the break around the edge. This is an excellent example of what mercury does to brass

nating both erosion and corrosion with reasonable cleaning of the bore.

Although the Remington Company announced the non-corrosive or "Kleanbore" primer in the .22 long rifle as their first development, this actually

Microphoto by E. M. Chamot

Winchester #225 non-mercuric, non-corrosive primer

was developed for experimental work in the .25/20 repeater cartridge. Analysis of this so-called great development shows that it is by no means original. It is very similar to the so-called non-corrosive or non-rusting shotgun primer composition used on the Continent many long years before Kleanbore primers were invented. The only major change was the *increase of ground glass.*

Microphoto by E. M. Chamot

Winchester #111 non-mercuric, non-corrosive revolver primer

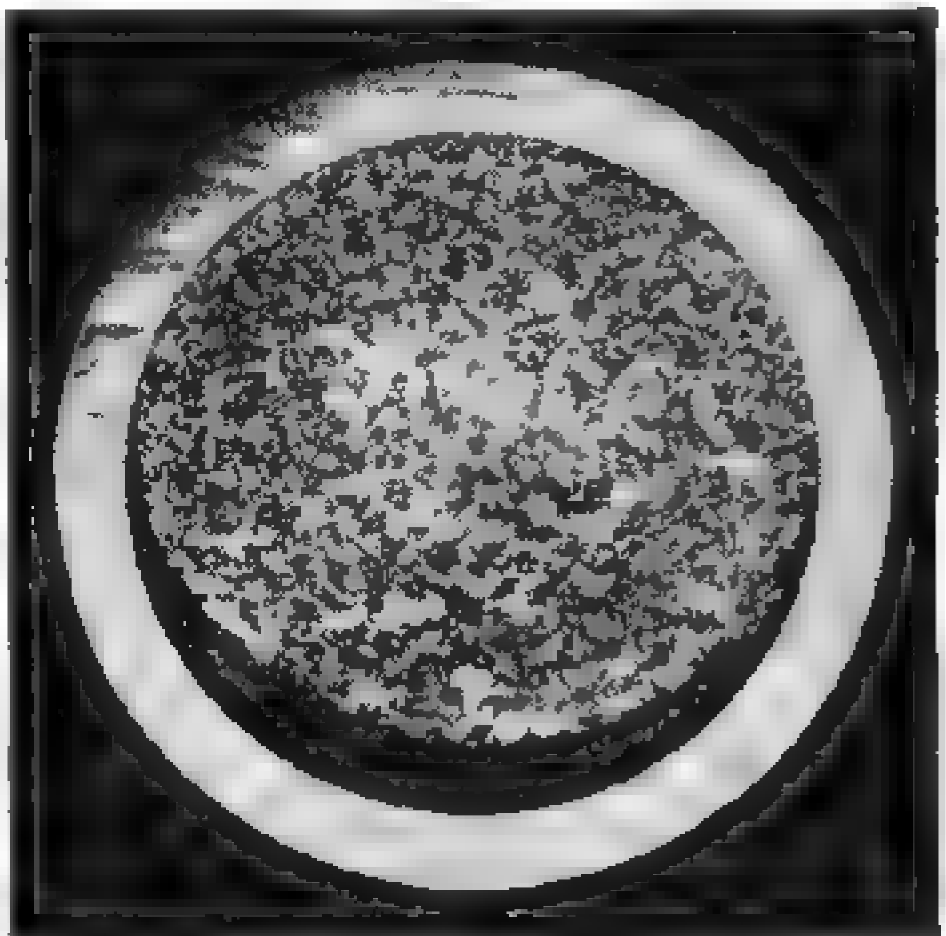
In primers there are two poisonous ingredients that are by no means satisfactory and the loss of which would be no great hardship for the shooter. These ingredients are barium nitrate and glass. The barium nitrate has, as a product of its combustion, barium carbonate, a severe abrasive, and of course powdered glass is wicked on anything.

Microphoto by E. M. Chamot

Remington UMC #39 rifle primer (now known as #8½)

Priming mixtures have been greatly improved however, within the last ten years. As a matter of fact, more than thirty patents have been taken

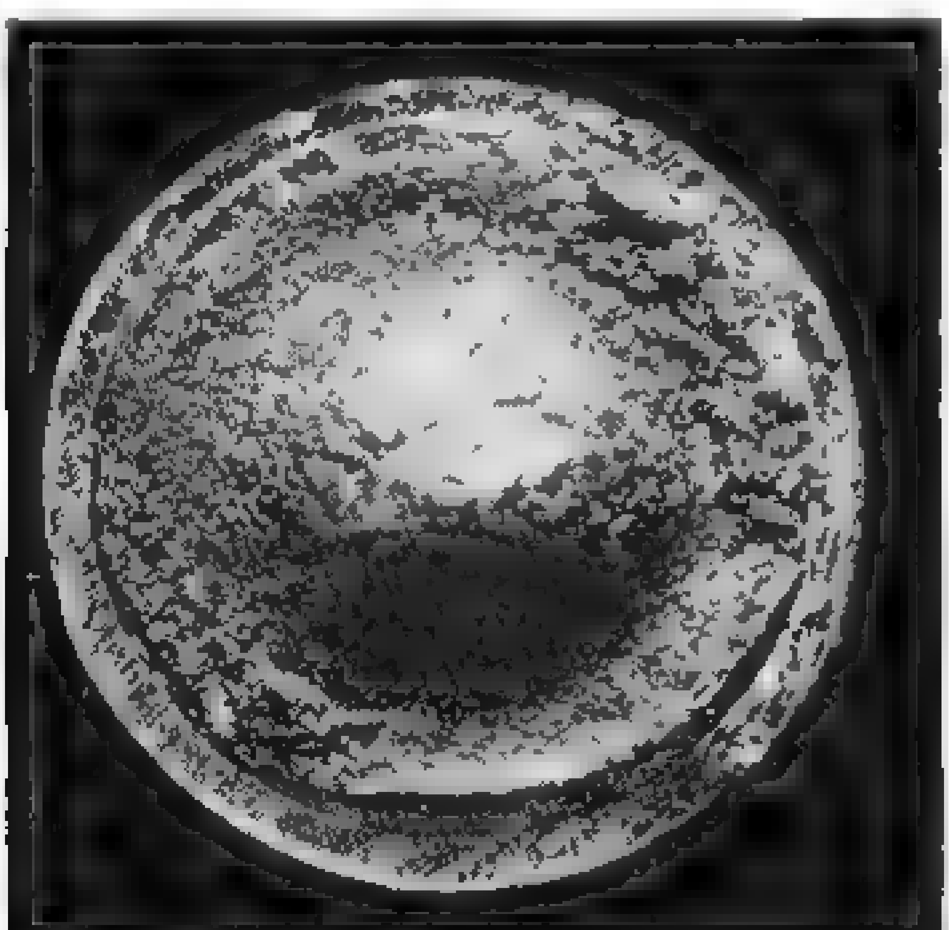
out on American priming formulas. Most of these patents really indicate that the person responsible for the development is by no means a practical shooter, as he does not understand the problems of barrel length. Many of these patented formulas



Microphoto by E. M. Chamot

Remington #1½ non-corrosive revolver primer

have never been used commercially because they are highly impractical. The author has had analyses made by reputable laboratories to determine the primer ingredients in modern non-corrosive primers of all makes. He has found a great varia-

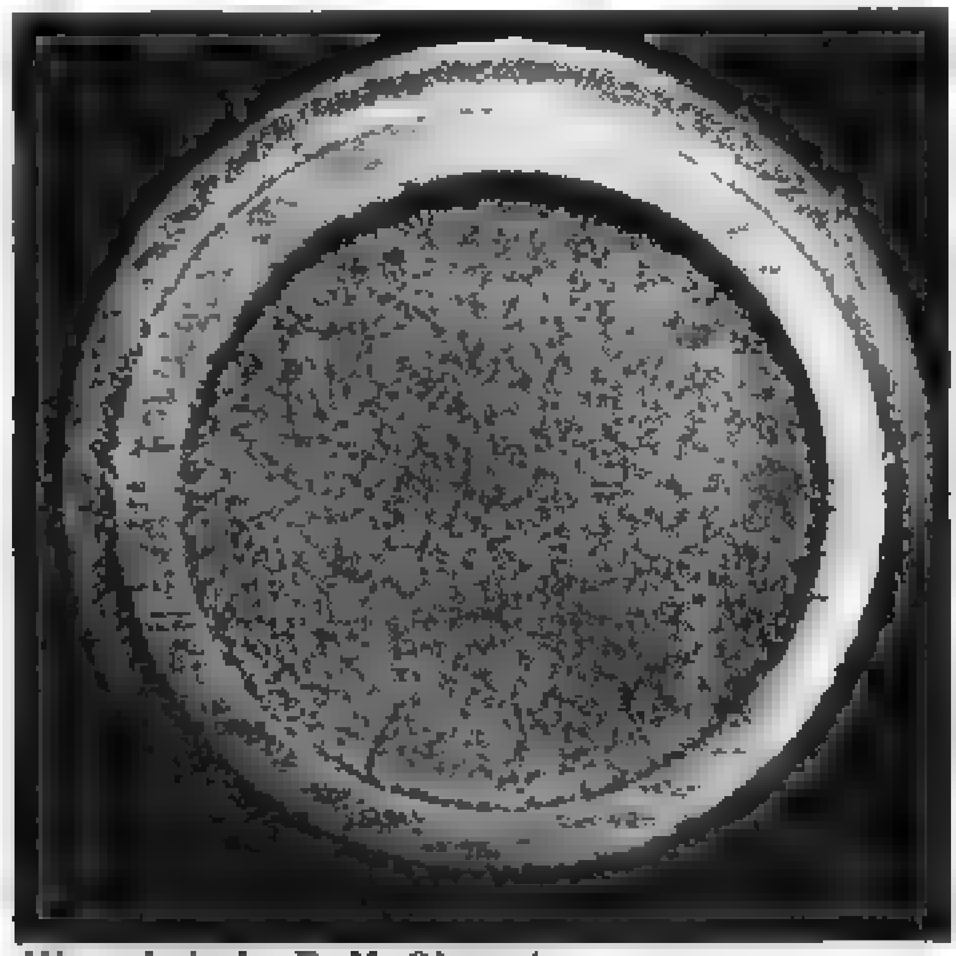


Microphoto by E. M. Chamot

Winchester #108 non-corrosive revolver primer

tion in formulas of different makes, indicating that none of the manufacturers are satisfied with any of their developments. It is primarily because of this that the United States Government has not adopted a non-corrosive primer. Until the military officials feel that the modern developments have been thoroughly stabilized and are reliable under all service conditions, they will not recommend them or seriously consider their adoption.

On the other hand, the non-corrosive primer is here to stay. Improvements are continually taking



Microphoto by E. M. Chamot

A primer of a German .22 rimfire cartridge as viewed under the microscope. This is of the non-mercuric non-corrosive type. Notice how much more uniform the pellet is than that used in the American primers

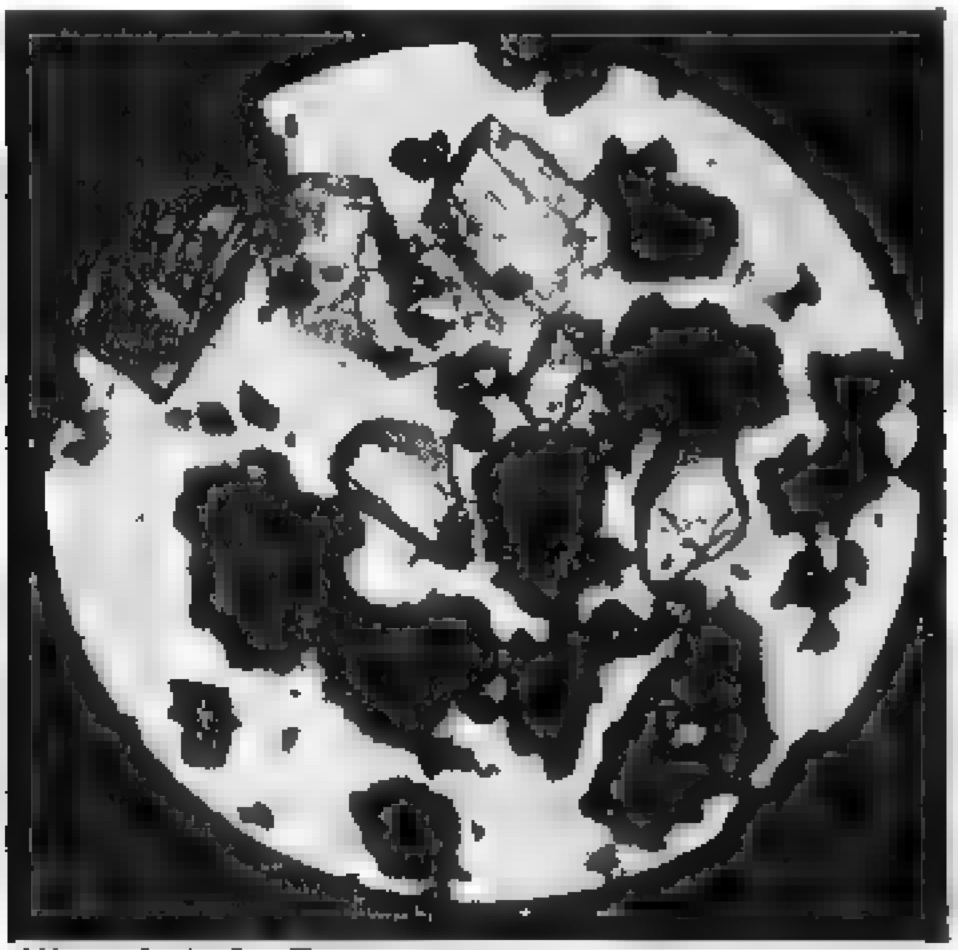
place, and one will not go far astray if he uses the commercial brand exclusively for his handloading. The formulas are being approved so rapidly that

Microphoto by E. M. Chamot

The Peters 20X non-corrosive mercuric type of revolver primer. This is bad medicine for the handloader

the problems of barrel wear and faulty ignition are rapidly becoming things of the past. It is not necessary for us handloaders to know what formulas are being used, but almost any of the developments will be found to be satisfactory.

The primary thing about non-corrosive primers is to use the particular primer designed for the particular cartridge. To use soft-cup handgun primers in rifle cases is to invite punctures. To use rifle primers in revolver cartridges is to invite misfires, poor ignition and over-ignition of powder. Certainly it will not increase the accuracy.



Microphoto by E M Chamot

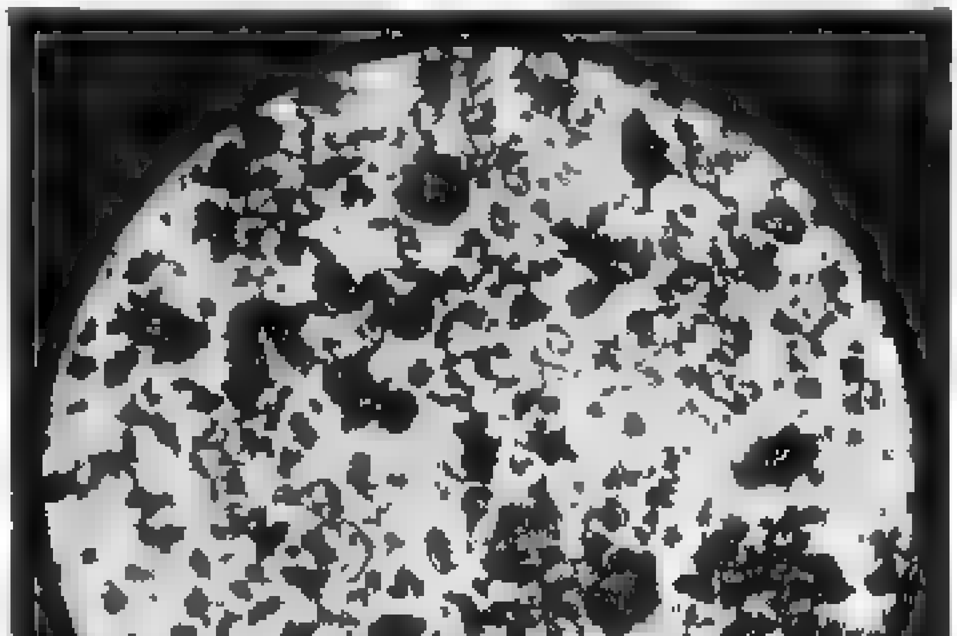
The microscope looks at the primer pellet of the Winchester #111 primer. The large transparent fragments are lead nitrate. Some of the black ones are antimony sulphide and some are the orange organic nitro compounds, partly transparent. Magnification 150X

As this chapter is being written, a letter from Al Woodworth of the Springfield Armory Experimental Department most opportunely turns up in the mail. "There is one thing handloaders should be careful about, and that is the non-corrosive, non-mercuric primer," Al writes. "I have seen many handloaders dump them out of the carton into a bottle or can, a whole lot of them at a time. It is a good idea to cork them up, of course, but one should handle them respectfully. I am against using a primer magazine on a loading tool primarily for this reason. In all my experimental loading, I always feed my primers one at a time. You just have got to see one blow once to realize what a volume of power there is in a column of primers. The last one I saw let go blew down through one inch of oak table top and into the floor and up through the loading-tool operator's hand. Despite the wound, he was exceedingly lucky, for it might just as well have been his head. Examination of the hand clearly showed that had the exploding primers struck him in any part of the head they might well have penetrated the skull."

What Mr. Woodworth says about non-corrosive primers is, of course, more or less true about any primer. However, the non-corrosive is a bit more sensitive to mishandling than earlier corrosive forms. Primers should never be stored in the sun or any damp place. The sun has a tendency to break down the priming pellet, so that decomposition actually starts before the primer is used. It is for this reason that a great many handloaders use bottles to store their primers.

The author personally uses nothing but the original containers and stores them in a normally heated and dry room. He has samples of some of the original batches of non-corrosive primers, including the early non-corrosive mercuric type released only experimentally and under experimental numbers. A few of these have gone bad in storage; for the most part, however, the same lots of primers have been found to go bad in storage in the factory-loaded cartridges, and have long since been gathered in from the market.

By all means, play safe when you handle primers. There is no one object in handloading as dangerous or as sensitive; and yet in handling more than 40,000 primers—it would be impossible to estimate accurately—the writer has only had two accidental explosions. Both of these caused no damage and were created by tipping the primer



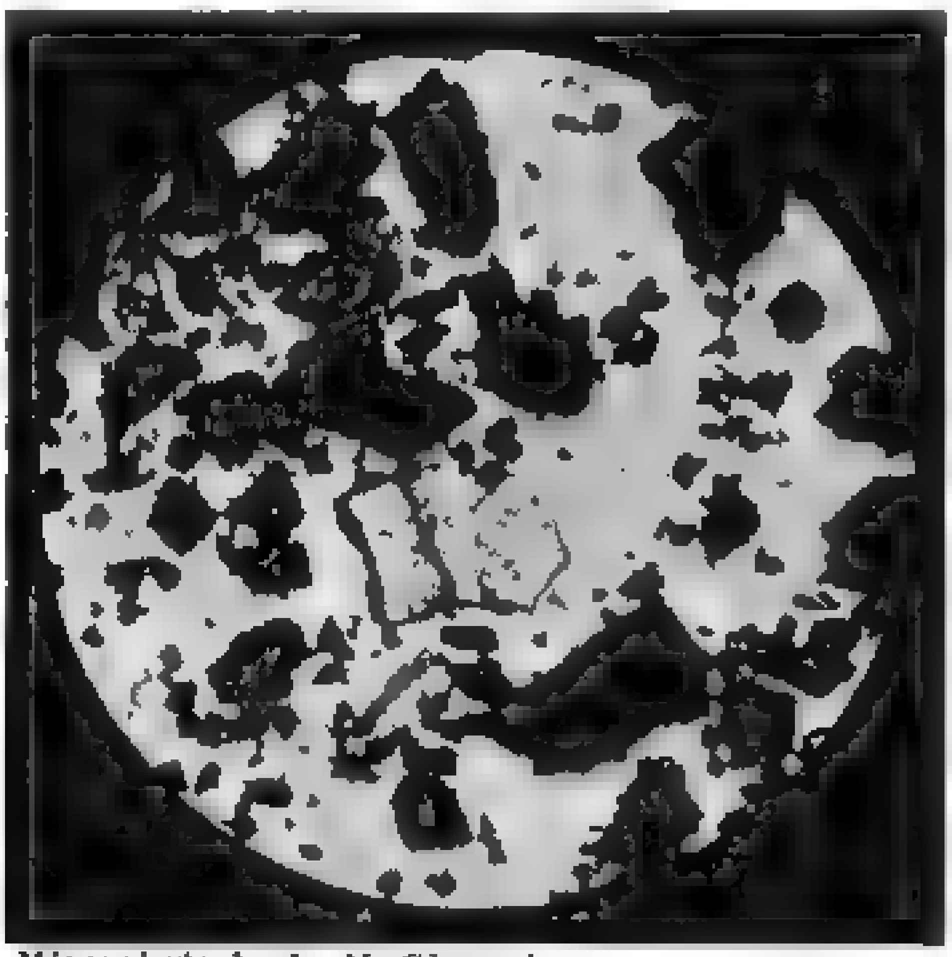
Microphoto by E M Chamot

The Winchester #111 primer under same magnification as previous illustration. Note difference in grain size

slightly while seating. In the priming department of the majority of large factories, the machines are continually exploding primers. An explosion automatically shuts down the priming machine, and it remains inoperative until the tender cleans out the fired shell, which is of course discarded. These machines are unusually safe, and, as they are auto-

matic, the operator is seldom close to the machine. They are protected in ways that no handloading tool would permit. Priming with the non-mercuric primers is a dangerous operation, but then priming with any primer is unhealthy. Use care and you will have no trouble.

It seems a little out of place to mention it, but it is not at all amiss to caution handloaders against attempting to dissect live primers. The fact that it can be done in the laboratory with suitable equipment has nothing whatever to do with the



Microphoto by E. M. Chamot

Another view of primer pellet mixture from the Winchester #111 primer. Same magnification as before

home consumption of primers. Whenever you attempt to remove the anvil from a live primer, look out for sudden disaster. Even in laboratories, the experienced worker always does his examinations with a heavy half- to three-quarter-inch shatter-proof glass shield between his hands and his face. Accidents frequently occur with the home mishandling of primers, and handloaders always blame them on the loading operation, no matter how foolish the stunt they have been trying. *Do not experiment with primers!*

It is an entirely different proposition to decap shells already primed, unless they have crimped-in primers. Any attempt to remove a live crimped-in primer invariably results in an explosion. This may or may not be disastrous. If tiny particles are blown into the hands, poison or lockjaw may result. If you should have an accident that breaks the skin, even though it may not look serious, immediately visit your nearest doctor and have an anti-tetanus inoculation. If this inoculation is resorted to within an hour or so, lockjaw rarely sets in. The cost is extremely low, and on many occasions the doctors are glad to grant this service free of charge.

If in priming your shells you have explosions in the tools, whether they be serious or not, investigate the cause. Examine the fired primers to discover whether it is the result of the primer seating punch or the fault of the operator. Intelligence will enable you to determine this with reasonable accuracy. An occasional primer might let go and create no cause for concern. If the handloader, however, explodes two or three primers in one evening, there is plenty of room for immediate investigation. The author could name at least half a dozen personal friends who have been handloading for fifteen to twenty-five years and never fired a primer when seating it in a cartridge case

One habit a great many handloaders have is to bang the primer seating punch home. It certainly speeds the operation, but the handloader pays an enormous price for the speed in the result. Actual tests made of ammunition loaded by one chap only a year ago showed that shells primed in this way, although they apparently fired correctly when shot in an off-hand position, raised the group size to more than three times that of properly primed shells when tested from a machine rest. A number of these primers seated "with a bang" were carefully examined by an elaborate process of laboratory work, using a microscope. The primed shells were first placed in a lathe and the head trimmed off very carefully until just the primer remained. Thus the primer could be picked loose with the fingers without necessitating the use of the punch. Every effort was made to keep from battering the primer after its original sharp seating blow. Then the primer was carefully dissected through splitting the primer cup and removing the anvil and wad. This showed very clearly that the primer pellet was cracked and crumbled from the blow. The microscope indicated that although a misfire was unlikely, varying degrees of hangfires were almost a certainty. Such hangfires give peculiar forms of delayed ignition, absolutely uncontrollable, and the net result is a widening of the target group due to lack of uniformity of ignition.

In other words, carefully weighed powder charges and hand-selected bullets are of no avail with crudely or carelessly primed shells.

It is well to bear in mind that there are two distinct types of primer pockets, the Winchester and Remington types being representative. If you cross-section a Remington cartridge case at the head, you will notice that the primer pocket is square at the bottom, particularly in the "corners."

The same cross-section of a Winchester cartridge case clearly shows a rounded-corner effect, leading one to believe that the primer-pocket-forming punch was more dull than that used by Remington. This is exactly the case, but there is a particular reason for it. The pocket in the head of the cartridge case is built to handle a very definite size and shape of primer. Thus let us look at the primers themselves.

The Winchester primer has its anvil projecting below the mouth of the cup. In shape it is entirely different from the typical Remington primer. The Remington anvil seats flush with the mouth of the cup. The Remington primer is designed to seat to the bottom of the pocket with the mouth of the cup in full contact with the sharp corners at the bottom of the pocket. The Winchester primer-cup mouth does not touch the bottom of the pocket, and the primer assembly is supported on the anvil. This is a matter of design; the merit of this type of primer does not enter into the discussion at all.

Let us see what happens when the primers are swapped in their pockets. The Remington primer, intended to be supported on the mouth of the cup, does not seat fully to the bottom of the primer pocket, with the net result that unless force is used, it is inclined to project beyond the head of the cartridge. When forced home, owing to the rounded-bottom shape of the Winchester primer pocket, the Remington primer cup must be "mouth-crimped" into position. On the other hand the Winchester meets with reasonable success in the Remington pocket, since it is supported on the anvil rather than on the mouth of the cup. It will therefore be seen that the diameter of primer pockets is only a portion of the problem at hand. If one intends to load extensively, he should acquire an assortment of primers of various makes to match his cartridge cases.

Another angle to the primer question: Remington uses a flat-top primer. The Winchester and Western form is slightly convex. To get the best of results—and this should be carefully considered by every handloader—the primer-seating punch should be designed to fit the particular primer on hand and should not be an all-round proposition. That is one of the major criticisms of reloading tools today. A few of our makers recognize the importance of using a proper-shaped seating punch and supply the necessary punch on order at the time the tool is sold. At the same time you may buy additional punches to fit other primers.

On the other hand, if one loads for both revolvers and rifle cartridges, a primer-seating punch to handle the diameter .210 large primer for the revolver series such as the Winchester #111 will also properly handle the Winchester rifle primer of the same size known as #120. The same is true of Remington primers in revolver and rifle sizes of the proper diameter. This cuts down the necessity of a large assortment of primer-seating punches. And since there are, generally speaking, but two sizes of primers on the market (eliminating FA .45 ACP primers and the special Winchester #225), and two types, four seating punches for a given tool will accommodate practically the entire line.

If these seating punches fail to fit the primer properly they may not visibly mark the primer but they will cause a crumbling of the primer pellet mixture or cake inside, creating the same problem of hangfires which greatly affects good ignition and accuracy. Examine your primers very carefully. After they are seated in the pocket they should be of exactly the same facial contour as before the seating punch was used on them. If they have been flattened or ringed, you have not done your part of the job properly, either through carelessness or through use of an improper seating punch. Thus you cannot expect accuracy equal to that of the factory loads.

Priming requires normal intelligence and an exercise of equal care. With this care comes skill, and with skill comes speed. When one begins at the game, in priming, as well as in all other operations, he should begin slowly, because here he has more of a chance to make serious and dangerous mistakes than in any of the other phases of the handloading field.

VIII

CASTING BULLETS

HANDLOADING bugs are divided into two very distinct groups—those who cast their bullets, and those who don't. The handloader who has not cast his own bullets has missed a great deal of the sport of loading, and sooner or later every experimenter will want to go into this phase of the game. Casting bullets is an economy which should not be overlooked, and yet it is not the simple thing a great many beginners believe. The handloader with experience in bullet casting will realize the truth of this statement only too well.

Some twenty years ago the writer began his experience with bullet casting. In those days the excellent moulds and other equipment today available were practically unknown quantities. The Ideal Manufacturing Company were the only people to supply bullet moulds and you took what they had available and liked it. The chap who experimented with other than the .30/06, .30/40 Krag and a few rifles in the .30/30 class was generally classed as a nut. Reloading for various military calibers was quite unknown. . . . Today there are nearly a dozen makers of bullet moulds. You can buy special bullets all cast. You can buy any type of mould and cast your own or you can design your own mould, have it made to order and thereby have a highly distinctive bullet which may or may not do things the way you originally expected.

The man who wants to cast bullets should make up his mind that there will be a great many mistakes in his early attempts; and he should definitely plan to study the mistakes as they occur, analyze them, and endeavor to prevent their recurrence. Proper equipment is essential to the satisfactory casting of bullets. The essential tools are a small lead-melting pot, a specially designed ladle with a pouring spout which will fit in the sprue cutter of the mould, suitable bullet moulds, and some form of resizing die and lubricator. The latter will be described elsewhere.

Bullet Metals. Next comes the bullet metal. In my correspondence with handloaders over a period of years I have heard of some peculiar things used with reasonable success in the casting of bullets. A successfully cast bullet must be of some metal similar to lead. Most bullets are cast of an alloy of which lead is the basic material. You can buy this bullet metal suitable for either rifle or revolver in various grades already made up and supplied by our major loading-tool companies. You can make it using scrap lead of various kinds and other materials to harden. Just how hard should this be?

The Ideal Hand Book states: "A mixture of 1 part tin to 30 parts of lead will be hard enough for revolver bullets and bullets for use in rifles with charges of black powder." This is in a measure true, but revolver bullets to be used with anything above the standard factory charges should be alloyed somewhat harder than the 1 to 30 mixture. Most professionals who believe in casting their bullets right will use a mixture of 1 to 20, and this is what my very good friend H. Guy Loverin of Lancaster, Mass., has practiced for many years. Mr. Loverin casts the majority of my bullets, as I have found his product to be unusually uniform in different lots. For super-velocity loads in the .38 Special and .357 Smith & Wesson Magnum, Mr. Loverin has supplied me with the special Sharpe hollow-point bullet in both 1 to 15 and 1 to 10. The 1 to 15 was very satisfactory for high-velocity use, and the 1 to 10 was even superior. Incidentally, Mr. Loverin's cast bullets played a prominent part in the development of the .357 Magnum cartridge during its earlier stages.

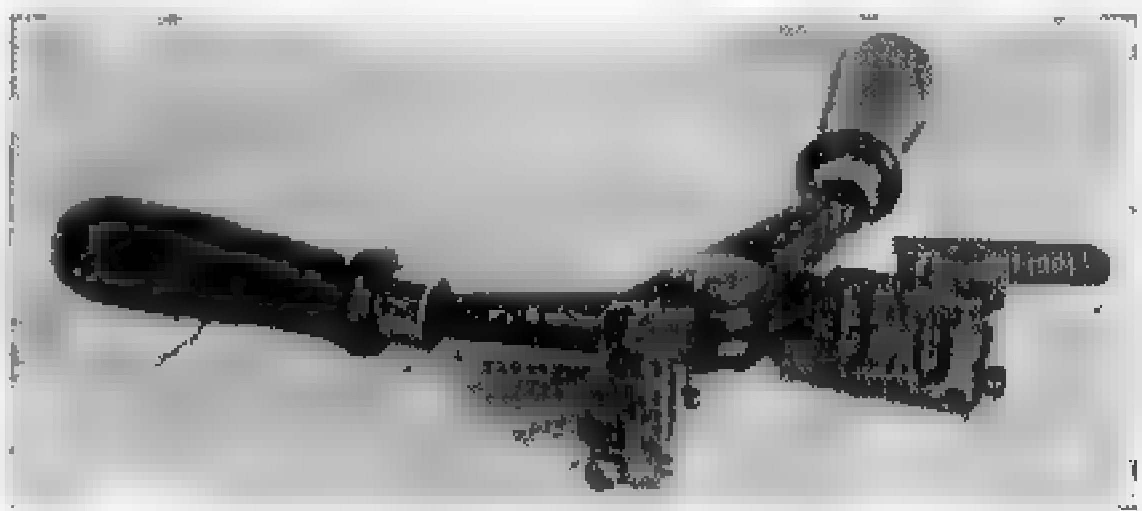
In the majority of revolvers of, for instance, .38 Special caliber, a 1 to 30 bullet driven at a velocity greater than 850 f.s. is inclined to lead the barrel slightly, particularly in the throat where the bullet enters the rifling from the cylinder. A slight amount of leading at this point will totally destroy accuracy until it is removed. Accordingly, we believe that for all revolver bullets in .38 Special caliber the alloy should be at least 1 to 20, although 1 to 25 or 1 to 30 will do quite satisfactorily for big bores such as the .44/40, .44 Special, .45 Auto Rim and .45 Colt. In the .38/40 and .44/40 High Speeds and the .45 ACP at least 1 to 20 and preferably 1 to 15 will give better results and finer accuracy. For rifle use 1 to 15 is the most satisfactory alloy for plain-base low-velocity loads, and 1 to 10 for medium-velocity plain-base or high-velocity gas checks.

The handloader who desires to mix his own bullet metal can utilize pig lead, scraps of lead pipe, etc., and harden it with block tin in the proper quantity. In large cities block tin is a very simple item to obtain. In smaller places it will be more difficult. It is always possible, however, to obtain ordinary solder of the stock variety. This may be of any grade such as 50-50 or a plumber's variety of 40-60 or 60-40. For the person who lives away from cities and finds it difficult to pick up solder, any of the mail-order houses will furnish this material at a very reasonable price from the plumbing and heating supplies section.

Salvaged metal is invariably the most economical from a standpoint of initial cost. It comes, of course, in varying degrees of purity. Commercial pig lead averages around 99.6% pure and is about as pure as any commercial product. Block lead is supposed to be pure and similar in specifications to pig lead, but it is inclined to vary to a considerable degree. Lead pipe is rated by metallurgists as of the same quality as commercial pig lead. Lead sheathing from electric cables is 98.5% pure. Old storage-battery plates are very satisfactory for such purposes. The unfortunate part is that they contain a large amount of lead oxide, and when a huge quantity of them is melted only a small amount of liquid metal is obtained. The oxide could be reduced to its lead content by a different process, but it is a process far too complicated for home execution; the oxide therefore must be considered as waste and skimmed off and discarded. This 10% antimony content will make bullets too hard for use in revolvers but satisfactory for rifles, particularly when used with gas checks. It can be softened somewhat by the addition of a small quantity of lead, together with a small amount of tin. As these plates vary somewhat, and as the process of melting them down also varies, it is nearly impossible to suggest the suitable amount of lead and tin necessary for the handloader to add; but with a reasonable amount of skill obtained through experience he can readily determine this amount by casting a few bullets and testing them.

In the preparation of bullet metals from scrap lead and solder the handloader can work out the proper alloys in a few minutes through the diligent application of a pencil on scrap paper. Fifty-fifty solder is 1 part tin to 1 part lead and is of course extremely hard. The addition of an equal amount of lead will make the resulting mixture 1 part tin to 3 parts lead. The addition of twice as much pure lead will mean 1 part tin to 5 parts lead. Nine pounds of lead and two pounds of 50-50 solder will make eleven pounds of bullet metal closely approximating the 1 to 10 mixture used for rifles. In casting the 169-grain .30/06 gas check this mixture will make approximately 450 bullets. Since the 1937 price of this solder is about forty-seven cents a pound and pig lead sells for about nine cents a pound, the cost of eleven pounds of bullet metal will be about $1.75 and the resulting mixture will be the equivalent of Ideal #2 metal selling at twenty cents a pound; in other words, $2.20, a saving of approximately forty-five cents plus shipping charges; and the latter is no small item for some men.

Ordinary metal such as is used in printing plants and in newspaper linotype machines is usually a



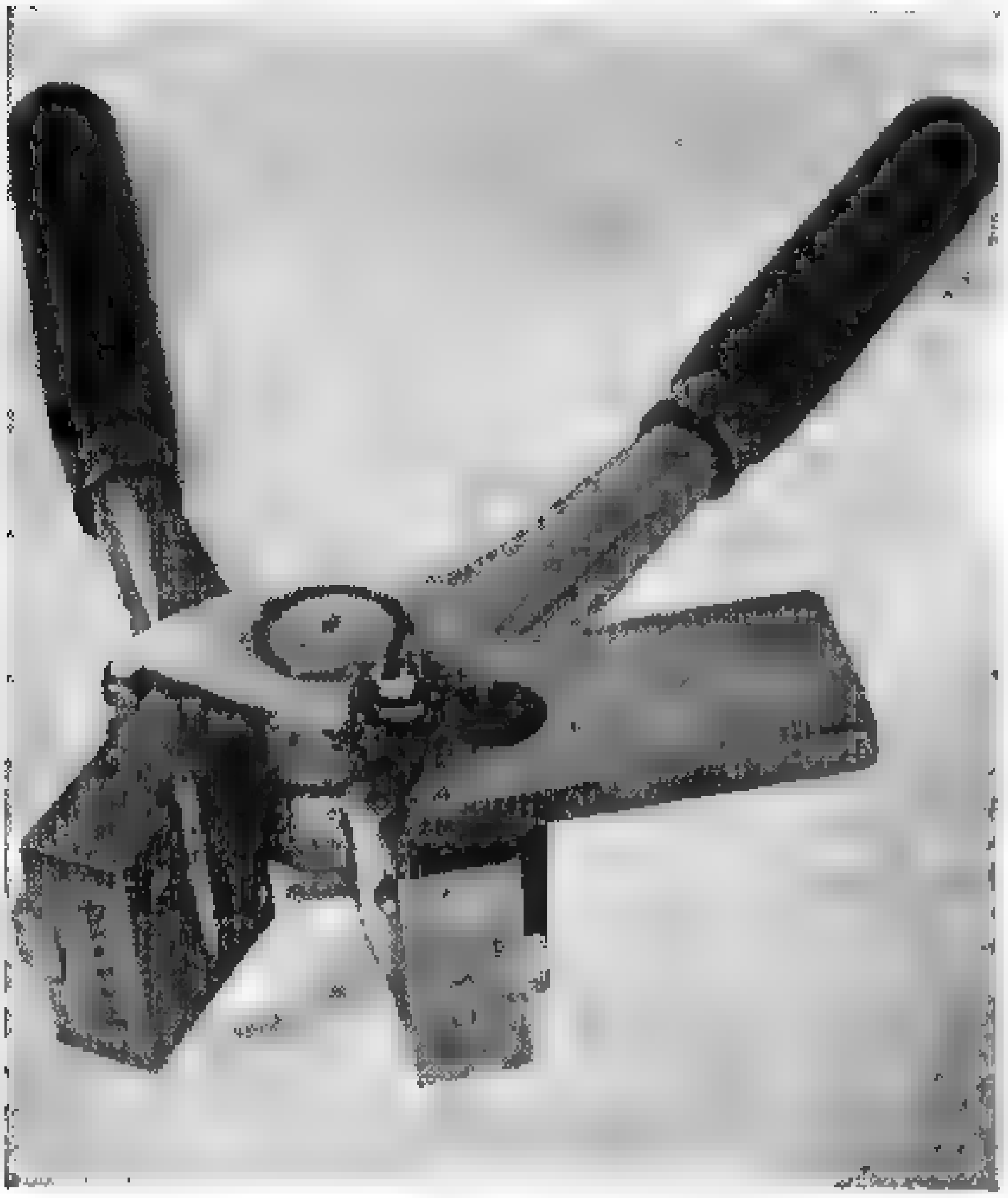
The Bond double-cavity bullet mould. An excellent design and nicely manufactured type with large sturdy handles

bit too hard for bullet casting. This runs about 15% antimony and 2 to 5% tin. However, in linotype machines it is continually re-used and becomes hard and brittle with age, a condition due to the burning out of the tin and oxidation of the antimony. Accordingly, it is the custom of newspaper offices to send samples at regular intervals to a laboratory for testing, and the metal is reworked through the addition of the necessary materials from time to time. The stereotype plates used for small cuts in newspaper offices are ordinarily of type metal, but the big curved stereotype plates used on newspaper presses are somewhat harder than the customary formula. If any of this metal should fall into the hands of handloaders it should have a considerable quantity of lead added to make it suitable for use.

Ordinary factory bullets according to today's formulas are rarely more than pure lead with a small quantity of antimony added to harden it. While tin is used in some bullets in very minute quantities, antimony is preferred, as it does not lower the melting point—one of the eccentricities of tin. The cores of most jacketed bullets are lead, hardened with antimony.

If you can obtain bullet metal salvaged from shooting galleries where .22s are widely used you will find that the bulk of this is pure lead with but

a small quantity of antimony. For practical purposes this salvaged metal is of no value in handloading unless hardened with a bit of tin, as the small quantity of antimony contained in the metal is usually lost in the melting process. Bullet metal salvaged from galleries where regular factory .38 Special and similar larger calibered revolvers are frequently used is inclined to be a great deal harder but is still a bit too soft for the handloader to use "as is." Factory specifications of Remington and Winchester on .38 Special bullets indicate that the mixture of 1 part antimony to 40 of lead has been standard for many years. This material in re-melting is still a bit too soft and should be hardened somewhat with a small quantity of tin. Ordinary "bird shot" designed for use in shotgun cartridges is an economical bullet mixture. The chilled shot is hardened somewhat with a small amount of antimony and for revolver use is usable without the addition of any hardening agent. This material may be obtained for approximately seventy-five cents for a five-pound package in certain sizes, and in some cases it is cheaper to buy this shot and melt it up than it is to attempt to purchase regular bullet metal.



The Belding and Mull single-cavity mould for a pointed cast rifle bullet. Note large handles, sturdy construction of blocks, and large and easily handled cut-off lever

Tin for hardening bullets can be obtained in several ways; first, of course, through the purchase of either block tin or solder. Many handloaders have a mistaken idea that the so-called "tin foil" wrapped around cigarettes, tobacco and candy is suitable for hardening bullets. Extreme care should be taken if it is desired to use this material, since extremely pure tin foil is difficult to obtain. The majority of these foils range in content from 10 to 60% lead, and most of the so-called "heavy foils" wrapped around certain kinds of pipe tobacco or certain brands of tea are almost pure lead with practically no tin whatever. Almost all candy and eatables are free from lead in the foil, as the pure-food laws do not permit lead to come in contact with foodstuffs. Most chocolate bars and similar candies use aluminum foil. Some candies use a mixture of lead and tin and protect the food by an inside wrapper of waxed paper. Most of the modern packages of tea are of pure aluminum foil. An easy test of aluminum foil for the beginner is to touch a match to it. If it will not burn or melt, but shrinks and curls up slightly, he can be certain that it is aluminum. If it is tin foil or lead foil or any combination of lead and tin, the flame of a match will melt it, and if held over a sheet of paper, tiny drops will be formed on the paper.

A very excellent source of salvaged tin, however, is toothpaste tubes. Here again food laws demand that *pure tin* be used, and rarely will one find any lead in tubes of this nature. The same is true of shaving-cream tubes, cold-cream tubes, and tubes which contain cosmetics. Any lead content is liable to create serious lead poisoning, and Federal laws are very strict in an effort to hold this form of poisoning to a minimum. Toothpaste tubes or similar scraps should first be melted separately to remove the enamel coating, which will form on the surface as a sort of scum. If a concrete floor is conveniently available, as in a basement, a good way of storing this pure tin for future use is to pour small puddles not more than an inch or so in diameter and gather them up as soon as the metal cools. They will thus be clean and free of débris and can be mixed with lead or any other alloy to harden as occasion demands. Still another method which has been tried by the writer consists of slowly pouring the melted tin into a pail of water, which cools and hardens it into an irregular mass. It can then be stored, after thoroughly drying, in paper bags, shot shell boxes, or any other container, and it mixes very readily with the lead when the scraps are stirred into molten bullet mixture.

Since this book was placed in the printer's hands, the Potter Engineering Company, of 632 Scoville

Avenue, Syracuse, N. Y., has developed an extremely useful accessory for the handloader in the form of a modified Brinell metal tester for determining the hardness of bullet metal. The gadget is extremely simple both in design and in operation. It represents a great deal of careful thought and skilful manufacture.

To operate it, one merely uses a slug or slab of prepared bullet metal such as has been used in the ingot mould supplied by Potter with their electric bullet caster, placing it upon a specially prepared flat table on the base of the tester. An upright arm properly graduated has a hook for the suspension of a heavy weight, and an indicator for direct reading from the table.

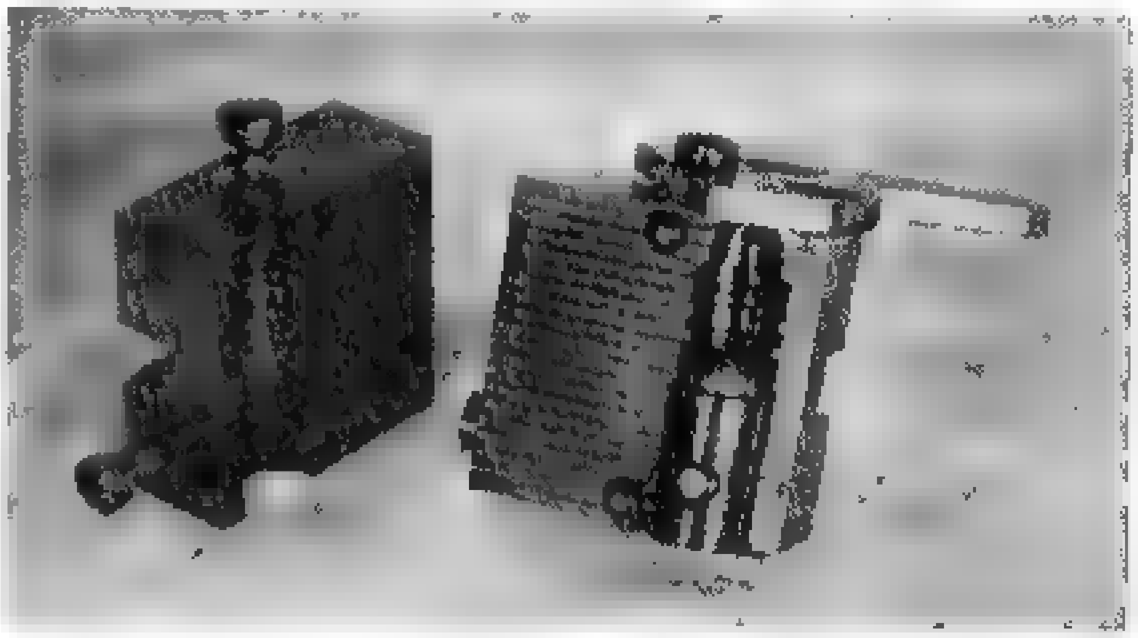
One merely lays the special cast slug, which has been smoothed in one spot by means of a file or knife, so that the ball end of the contact rod just touches the alloy. This is zeroed by means of a knurled nut so that the indicator reads at zero. A special two-pound weight is then hung on the beam arm so that it is free to settle down, forcing the ball end of the test prod into the slug. This takes place quickly, and when the settling is slowed to a minimum, the reading is taken.

The beam scale is graduated from zero to a point marked T, 10, 15, 20, and 25. The T refers to the standard hard antimony alloy used in type metals, while the other marks indicate the usual bullet alloys of from one part tin to ten lead up to one part tin, twenty-five lead.

It must be understood that in use this tester is essentially comparative, and readings must be made quickly. A few moments' practice will enable the user to determine results accurately enough for his purpose and thus permit him to maintain a uniform alloy at all times. When using metal from the large pot, it is a simple matter to cast a few slugs from time to time, place them opposite the tester, and determine quickly if the tin used for hardening is being burned out in the melting process. If the weight is permitted to stand on the slug, it will continue to settle and force the prod into the metal—very slowly; but with reasonable care one can learn to read the instrument quickly and accurately.

This should be used by every handloader who seriously considers uniform results in his bullet metal. The author knows of no other instrument available to permit of testing. It should be borne in mind that tests should be made in the uniform place on the slug and a reasonable check made against a known alloy. No form of casting is uniform in hardness, particularly when lead alloys are used. The center of the casting is inclined to be softer than the edges, since the contact of the cold cast-iron of the ingot mould is likely to chill the surface very quickly and cause more shrinkage on the outside than on the inside.

Bullet Moulds. Bullet moulds should be carefully inspected and treated with a certain amount of reverence before, during, and after the casting. A mould is a delicate affair. It can be ruined through mistreatment, causing it to warp and therefore to cast "egg-shaped" bullets which are decidedly out of balance and not inclined to give good accuracy. Most modern moulds of any manufacture which the writer has examined ap-

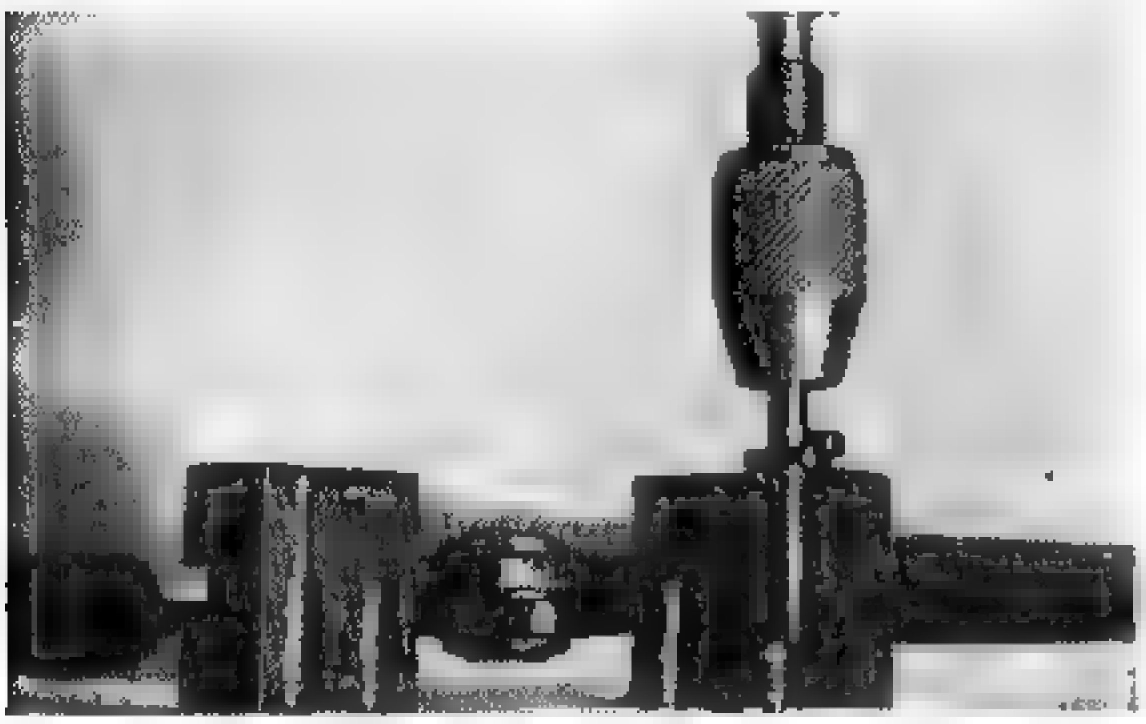


The Bond hollow-base attachment on a .45 pistol bullet

pear to be reasonably well made and line up perfectly. The moulds should be properly blocked and vented. This is a subject difficult to describe and in some cases more difficult to do. If a mould fits together very tightly and still casts imperfect bullets despite the efforts of the user, then it is quite possible that it needs to be vented—in other words, ventilated. The vents consist of fine hairline grooves running from the cavity to the outside of the block in numerous angles and directions. No two skilled operators who have vented their own moulds will definitely agree on just how this should be done. One thing, however, is of extreme importance: these vents should not be made too deep. It is best to make the scratches extremely shallow, try the mould, and then re-cut them if necessary. The scratches must be carefully made so that there are no burrs to prevent tight closing of the mould. It is best, however, for the beginner to return his mould to the manufacturers if he is unable to get perfect bullets. They will test it for him and if necessary will do the venting for a very small charge.

This venting problem is peculiar in that each individual mould requires a more or less different form of handwork. A great many mould makers test-cast with every bullet mould they manufacture, and usually they attempt to vent it at the

time. A mould may give perfect results in the hands of the testers, and yet when it comes into the possession of the handloader the usual troubles may appear. The simpler types with one or two grooves rarely give as much trouble as the multi-groove types, in either rifle or revolver. This venting must be checked by actual test. At least a dozen bullets are thrown with every effort made to turn out perfect specimens. Each bullet is then carefully examined and the weak points noted. Some moulds require alteration in the form of venting of a single groove. Others require from



The Hensley mould with hollow-point attachment

two to the entire cavity to be thoroughly vented. Avoid over-venting.

The best way to do this job is with a very short hold to guide your file and prevent slippage. Gently score a scratch or two from the outside edge of the blocks to the troublesome groove, scoring, of course, on the mould faces which clamp together. The mould should then be tested. If the venting is not sufficient, try again. Your vent should be deeper at the outer edge of the blocks than at the cavity proper, and at this point should be less than the thickness of a hair. Be very careful not to turn a burr into the cavity, as this will cause bullets to stick or will create an uneven casting. Do not attempt to use sandpaper or any other harsh abrasives on these faces or you will totally ruin the mould, necessitating the return of the blocks to the manufacturer for re-cutting—which is nearly as expensive as a new pair of blocks. Frankly, I do not believe in the recutting of any blocks. Warpage, improper castings and similar problems are frequently traced to defects in the block material—hard and soft spots in the iron. If a mould is too balky after your best attention in venting, it is best to throw those blocks away if the manufacturer will not make good and try again with another pair.

The moulds should be heated and maintained at a very definite temperature which only skill will determine. If it is too hot the bullet will take on a crystalline or frosted appearance, and some shooters doubt that bullets of this type are satisfactory for use in a firearm. The writer, however, has experimentally fired numerous bullets deliberately cast this way, and by the time they had gone through the sizing and lubricating dies the frosted appearance had disappeared from the bearing surfaces and no difference was noted in their firing.

If the bullet mould is used at too low a temperature, imperfect bullets will result. The user may throw a great many bullets which do not even partially fill the mould. Needless to say, no attempt should be made to drop these noticeably defective bullets in with others. They should go into the scrap box immediately and be used for recasting purposes. If the mould is slightly under the proper temperature, fine seams or hairlines will appear in the nose of the bullet. These may or may not affect accuracy. The writer has deliberately tested such bullets in .30/06 caliber, shooting them with precision loadings in a Match barrel mounted in a machine rest. These bullets with defective noses for the most part gave accuracy equal to the so-called "precision" bullets, but no critical handloader would care to display materials of his own construction which were so evidently defective.

Lapping the Mould. If your bullets do not drop free of the mould with reasonable ease into perfect castings, and if they show numerous tool marks indicating a somewhat rough interior of the cavity, the mould should be lapped. This is not a difficult job but is one requiring more than ordinary care. The best way to lap a mould is to bring it to operating temperature, slide aside the spruce cutter, and cast a bullet of pure lead around a nail. The nail may be embedded in the bullet by slightly flattening it at the point and holding it with a pair of pliers while the molten lead is poured into the mould to fill the cavity. The surplus lead is trimmed off with a knife, thus leaving a bullet cast in the shape of the mould and mounted on a short shank. This may be trimmed off slightly to fit into the ordinary hand drill, and the result is a perfect lap.

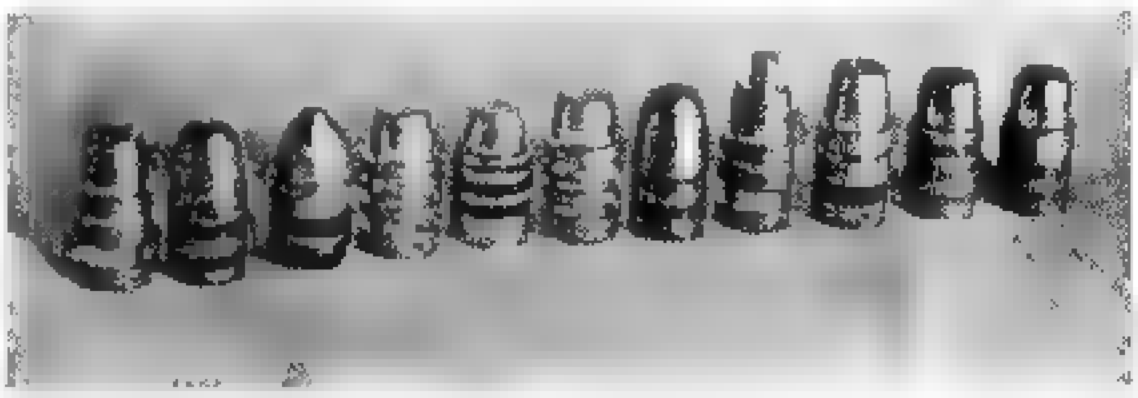
In using this lap, it should be wet in either oil or water and a small quantity of very fine valve-grinding compound smeared over its surface. The mould is permitted to cool and the lap inserted gently while the blocks are clamped securely in a vise. It may be necessary to space them apart with small pieces of heavy wrapping paper; this is

usually advisable for the initial stages of lapping. Otherwise, the lap will not turn freely in the mould. It is spun very slowly and gently through the use of the drill, and the blocks should be examined at frequent intervals. The lap will wear down much faster than the iron of the bullet mould, and this must be taken into consideration in determining the final size. Stop the lapping operation as soon as the tool marks have been removed from the interior surface. Continued use of the lap will only make the mould over-size and otherwise change its contours. After the lapping is completed, the blocks should be thoroughly washed in gasoline or boiling water to remove all traces of valve-grinding compound or other abrasive and it is then ready for use in casting bullets. This lapping process can usually be conducted in less than an hour even when the operator uses extreme care. The actual lapping of the mould rarely takes over a few moments and *must not be overdone.* A great many experienced handloaders lap every mould they receive, as this is necessarily a hand job which would add tremendously to the cost if it were done in each case by the manufacturer.

Breaking in a Mould. After any lapping is done in a pair of blocks, it becomes necessary to break them in all over, much the same as a new mould. The breaking-in process can be done quickly or slowly; the slow method is far more reliable, but the quick process can be tried by the careful workman. It is done either in a gas flame or blow torch, and it is well to point out that the stunt is dangerous. The torch should be used very sparingly to blow a sheen or "heat blue" over the inner face of the cavity. If the heat is applied to the blocks for too long a period, it may warp them out of shape, thus ruining them. The best way is to cast bullets in the blocks, throwing them in the scrap and keeping at it, until the mould commences to behave properly. In this respect a great many handloaders get busy with files, scratch-awls and what-not, and start venting their blocks altogether too soon, when the real problem is not one of venting but of breaking-in the mould. A properly broken-in mould should cast a perfect bullet. The two edges should match up with precision and show little or no signs of fins where the halves come together. There should be no seams in the castings and every groove should fill out to the exact contours of the cavity. Many a handloader thinks he is getting good bullets when the square surface bands on the bullets are actually rounded owing to failure of the metal to reach the corners of the cavity grooves. Watch this carefully.

Not long ago a friend of mine had a standard bullet mould built by one of our better manufacturers which in some peculiar way had apparently slipped by the inspectors. Cold, the mould looked perfect. Heating gave it unmistakable signs indicating that the two halves of the blocks had been manufactured of different types of iron with an unrelated coefficient of expansion. The result was that each half gave a different size of bullet; the bands would not line up, and all castings were, of course, useless. The mould was promptly returned to the manufacturers, who replaced the blocks without argument. If you have a new mould which does tricks like that, don't play with it, send it back!

Casting. To cast bullets, you have to start right. There is a very definite equipment which



A few revolver bullets for the .38 Special showing the variations possible in different styles and weights for different purposes

is needed, and the only way to get good results is through the use of this equipment. In the first place, you need a small or medium-sized cast-iron melting pot. These are not expensive and can be purchased for half a dollar or so. A special small size is manufactured for handloaders, but any melting pot available through plumbing supply houses would be satisfactory for the purpose. Do not attempt to use melting pots of any other metal than cast iron.

The next item of necessity is a pouring ladle. This is an item manufactured or supplied by all mould makers and has been standardized for half a century. It is a small, egg-shaped ladle with one quarter sliced out of an end to permit proper filling by dipping in the molten mixture of metal. The opposite end has a round-nose pouring spout that fits the standard sprue cutter hole of all makes of moulds. Do not attempt to pour the molten metal with simple ladles, as spillage is bound to occur and the number of rejected bullets or imperfect castings will more than offset the initial cost of the right ladle. Although there are many makes, they are nearly all identical and sell for about fifty cents. The melting pot, ladle and mould are all the equipment the handloader needs to purchase in addition to his mould blocks with

suitable handles to support them. Other materials may be obtained around the house.

When the author desires to do a bit of bullet casting, he chooses an evening or afternoon when the boss of the kitchen is out. It is surprising how much better results can be obtained if one doesn't have to abide by a series of "don'ts" laid down by the official head of the family. He uses a blanket or heavy Turkish towel to catch the bullets. These must never be dropped on any solid surface, as they are very delicate when heated and nearly as delicate afterward, and must be treated with more caution than a case of eggs. The blanket or towel can be supported to form a pocket with the bullets dropped on the sides of this pocket and permitted to roll gently toward the center. In experimenting, however, each handloader will acquire certain very definite ideas on the subject; what is the most efficient for one will be unsatisfactory for another.

We usually spread the heavy Turkish towel, folded once, in the center of the kitchen table. The melting pot is placed on one of the plates of the gas range and the heat applied to melt the metal. The full blast of the gas range is used for this purpose, but once the metal is properly melted, blended and brought to temperature, the heat is turned down to maintain it at an even temperature without permitting it to become too hot. If heated too highly, the metal oxidizes rapidly and does not cast perfect bullets.

Then comes the question of heating the mould. It is very important that your mould blocks be brought up to proper operating temperature. This can be done in two ways. First, by taking a cold mould and attempting to pour bullets. It is doubtful that you will get a half-size bullet on your first half-dozen attempts. It may take two or three dozen bullets to bring the blocks to operating temperature, and this is unnecessary work. The writer prefers to heat his blocks by opening the jaws slightly and laying the mould on the gas plate near the melting pot so that it gets a narrow edge of the gas flame. It is turned very frequently and watched carefully. Heated improperly, it is inclined to warp either permanently or temporarily. No instructions could possibly tell you how to heat the mould properly. We can merely start you off and the rest you must learn by experience.

Two interesting bullet moulds. Left: The old obsolete Ideal for casting different lengths and weights of rifle bullets in a given caliber. Length of bullet was determined by adjusting the screw and sliding cavity plug. Right: An old H. M. Pope mould with peculiar double cut-off plates. Bullets were poured from the point. This was supposed to cast more perfect-base bullets

Never dip your mould into the bullet metal to bring it up to operating temperature. I saw a beautiful pair of blocks totally ruined by this process. The blocks were brought to temperature, but the mould was tinned inside and out, and instead of casting a bullet, the metal entered the cavity and was soldered quite solidly in position, thus sealing the blocks. Heating in a gas flame was necessary to free them, and though the metal ran out, the tin surface still remained and an attempt to burn it off by still more heat resulted in warping the blocks beyond repair.

There are two things to be taken into consideration when you cast in the kitchen; first, the ire of

the head of the house, in case she returns and finds the floor spotted with burns from spilled metal; and second, the very unpleasant sensation of spilled metal distributed over various parts of your anatomy. There is absolutely no need of spilling metal if proper care is taken. When a gas range is used, the modern types invariably have a porcelain-enamel "drip" pan beneath the burners. This pan was not designed for salvaging lead, and the spotless white porcelain will take on peculiar brown spots wherever melted lead is spilled on it. While it will still be serviceable, one has to remember that those brown spots will create a lot of disturbance in household affairs, and they can readily be prevented by placing two or three layers of ordinary newspaper on the drip pan. Any accidental spillage will then drop on the paper, and if three layers are used there will be no burning through. Frequently a single layer will do the trick.

Thus with the folded blanket or towel upon which the hot bullets are dropped, your melting pot, mould and ladle brought to temperature, you are now ready to cast. The ladle, not previously mentioned, is brought to temperature through the simple process of submersion in the melting pot until it pours the hot liquid freely. You then need some form of hammer to operate the sprue cutter, because you will find with a single brief trial that there isn't much satisfaction in endeavoring to push that gadget around to trim off sprue through the normal application of a bare thumb. It gets kind of warm. Some chaps use hammers for this purpose. To hit a mould with a hammer is an unpardonable sin in this author's eyes. A wooden mallet is far more satisfactory, and since a great many handloading bugs do not have a wooden hammer, a short 8- or 10-inch section of hardwood can be used with equal success. Thus equipped, you are ready to pour your bullets.

In use by the normal right-handed operator, the mould blocks are held in the left hand with the sprue cutter closed, the ladle filled with the molten metal grasped firmly by the handle with the right hand. The mould is then held over the melting pot so the cavity is in a horizontal position. The snout of the ladle is placed against the sprue-cutter pouring cavity and quickly but gently swung into an upright position. The weight of the molten metal in the ladle will expel all air from the cavity and force the liquid into all grooves if the mould and metal are of proper temperature. The ladle is held in this position for a bare fraction of a moment—usually two or three seconds—whereupon the two units are again turned so the mould cavity is horizontal and the ladle separated from the sprue cutter and returned to the melting pot. An experienced operator will leave a tiny puddle practically filling the sprue cutter proper, but will not overflow his metal onto the sides of the mould. Such an overflow is somewhat messy but not exactly improper. The salvage can readily be made, of course; but that kind of bullet moulding is in much the same class as spilling one's primers and powder all over the floor while using them.

The mould is again turned over on its side, and with the mallet or block of wood in the right hand, the sprue cutter is struck smartly to shear off the sprue or surplus metal. This process is very simple. Many handloaders recommend that the sprue be sheared off and dropped back into the melting pot all in one operation. This may be all right for an experienced operator, but the beginner should never try it. A block of cold lead doesn't splash easily, but in its liquid state it is surprising what tricks it can do when one carelessly drops a piece of bullet metal from a given height into the melting pot. One splash on the operator's hands or clothes, and he is permanently cured of carelessness. In case you have never been splashed with hot lead, it will be just as well not to experiment along those lines. The easiest way is to use a small tin or wooden box—even heavy pasteboard will do—and knock the sprue into it. When a sufficient amount has been accumulated and it is necessary to replenish the metal in the melting pot, these scraps can be added very conveniently along with any bullets which have been rejected because of flaws.

It should take only a few seconds for your bullet to set properly in the mould. Do not permit it to remain too long or both the bullet and the blocks will cool, so that there will be a certain amount of sticking, which, at the best, is very inconvenient. The operator should swing his moulds over the blanket or folded towel, open them as close as he can to the cloth, and permit the bullet to drop out. A towel or blanket on a flat surface is extremely convenient, and while many operators prefer a pocketed affair which permits the bullets to roll to the center, I do not recommend it. You can choose your spot on the flat surface and drop the bullet accordingly, so that it does not come in contact with other bullets. As casting progresses and the blanket becomes covered with cooled bullets, they can be gently rolled with the finger tips into a group at one side where they clear the surface for additional castings. You will also find that your wood mallet or "hammering stick" is useful for the speedy closing of the sprue cutter.

An old metal spoon or even an ordinary teaspoon is convenient to have lying on this blanket. If you drop a bullet and notice any defects, discard it at once. It will be too hot to be picked up by the fingers but can be scooped up readily by the spoon to be dropped into the scrap box along with sprue cuttings. This will simplify your inspection of finished bullets.

Once the bullet is dropped from the mould, return immediately to the casting process; otherwise the blocks will cool too much, resulting in a defective bullet on the next cast. Some bullets drop out easily and without effort on the part of the operator. Others completely refuse. In case bullets constantly stick in either half of the mould, examine the troublesome half very carefully to see if any burrs have been accidentally raised. If there is the slightest burr or dent caused by a foreign substance coming in contact with the edges of the cavity, your bullet is more or less certain to stick, and the removal of such a burr is an extremely delicate procedure. The best way to remove that is through the lapping process previously mentioned. *Never,* under any conditions, pry the bullet from the mould with any sharp instrument. There is no surer way of damaging the blocks beyond repair. Take your time in casting; speed comes with experience. Hurrying is never successful.

Occasionally, even with properly "house-broken" bullet moulds, a bullet will stick in either half from time to time. Tap the open mould blocks gently with a wood hammer or mallet to cause the casting to drop free. In doing this, one will find that it is often possible to drop the bullet by tapping gently on the *opposite* half of the block rather than that half to which the casting clings. A series of very light blows is usually more effective than a single heavy blow.

Multiple-cavity moulds should be treated with extreme care and both cavities should be used. Some experienced casters refuse to use the second cavity for dual casting, pouring first one and then the other and dropping a single bullet at a time. They insist that this distributes heat far more evenly and prevents warpage.

Another handloading bug never attempts to cast with a single mould. He always arranges to cast up a series of two or three different bullets, using as many moulds but casting from the same alloy. He stands his moulds on end around the lead pot and starts his casting. As soon as his mould gets too hot, thus frosting his bullets lightly, he lays it aside and tries another mould. This man has been casting bullets for more years than I can remember and has acquired excellent speed at it; thus, when he "gets ahead of a mould" he can lay it aside temporarily and use another. In this respect I recommend that when several moulds are being used at the same time, they should never be of the same shape of cavity. For precision results, bullets

Another multiple mould by Fielding B. Hall. This casts ten .38 Special bullets at a time. Notice twin bullet moulds combined on one set of handles. Extra heavy sprue cutter on top readily shears sprue from ten bullets

from different moulds should never be mixed; and if each mould used is of distinctly different size and shape, the inspection process will enable one to sort them out without undue effort.

There is more argument about the melting and alloying of bullet metal than on any other single subject in the home manufacture of projectiles. The best method of melting and alloying is first to determine the amount of bullet metal to be made up. Bear in mind that 100 bullets weighing 170 grains each will use up at least 2½ pounds of bullet metal, and that for efficient results an addi-

tional supply of 2½ pounds should be kept in the melting pot at all times. It would pay the handloader, therefore, to make up from 10 to 20 pounds of a certain alloy and cast it in suitable bars or pigs for future use. These pigs can be formed very readily by manufacturing light wooden troughs or using ordinary small wooden boxes. As the alloy is made up, these boxes are cast full of the molten metal. The wood will char to a certain extent but can be used several times. After the pigs are cast, the exact contents should be written on them by means of a sharp nail or scratch-awl, whereupon they can readily be stored for future use. Bear in mind that the smaller these pigs are made, the more easily they will re-melt during the bullet-casting process.

Weigh out the required amounts of raw metals and first melt the lead. A spoonful or two of powdered charcoal can be thrown in on top of the molten metal, which will keep it from oxidizing to any great extent. If you use a tin alloy, you will have no trouble melting this lighter metal, as the tin will disappear promptly upon being inserted into the liquid lead. If antimony is to be added, the molten mass must be brought to a much higher temperature. Bring the lead to a temperature just under red-hot. This can be tested by insertion of a small stick of ordinary hardwood. It should char the wood after an insertion of an instant or so. The antimony is added in small chunks. It has a higher melting point than lead or tin and requires some time to melt. It does not mix readily with the alloy, and the mass must be stirred frequently to blend it properly. Dross or waste will accumulate on the surface, but avoid skimming this as much as possible. Instead, it should be fluxed by dropping in a bit of grease; an animal grease such as tallow is better than mineral grease, and a small piece of beeswax will prove superior to both, but a reasonable quantity of any form of grease must be used. A lump at least ¾ inch to a full inch in diameter works best; and, incidentally, this process should be performed near an open window—with the draft in the right direction. Any bullet lubricant such as Ideal, Belding & Mull, Japan wax, etc., may be used in this fluxing process, and one is about as good as another. The heat of the metal will burn this lubricant, thus creating a dense smoke—another reason why the job should be done while the wife is away. Sometimes the grease will take fire and burn off. At other times it may be burned away by holding a match in the smoking mass.

After the metal is properly stirred and the blending completed at these high temperatures, the heat is turned down and the metal permitted to cool to operating temperatures. After it comes down to this point, the charcoal and sludge may be skimmed off, but it should not be skimmed while the metal is at the extremely high temperature required for proper melting of antimony. Otherwise, rapid oxidation of lead and tin will result Experienced operators prefer to add the antimony

Gang moulds are often useful for speed casting. This one, designed by Fielding B. Hall of Los Angeles, throws five .38 Special bullets in a single cast

first, and then, when it is cooled, the tin is dropped in. This is the better way, since the tin may be burned out at the high temperatures necessary to melt the antimony.

Should molten bullet metal be stirred? Some operators assert that this is vital. Others insist that it merely accelerates oxidation. Antimony bearing metals should be stirred occasionally but never too vigorously. There is a slight tendency for the antimony to separate from the lead and tin, hence the stirring is more or less necessary. A friend who does a great deal of bullet casting uses a large capacity pot with a plentiful supply of bullet metal He uses a small iron ring about 2½ to 3 inches in diameter and drops this into the melting pot. It

will float on the surface of the lead and the entire unit is then permitted to "scum over" with the exception of the interior of the ring. The accumulation of dross on the outer surface prevents further oxidation and wastage of metal while the small surface inside is kept properly skimmed and bright. All dipping is done through this ring. Incidentally, skimming is accomplished more easily if a small piece of bullet lubricant, tallow, beeswax or other fluxing material is tossed into the pot.

A great problem in bullet casting is the sticking of the metal to the mould. This may be in the form of a perfectly cast bullet refusing to part company with either half or the more frequent problem of a soldering effect in which the sprue sticks very solidly to the sprue cutter, thus effectively blocking the mould and slowing up the casting. In cases like this, the problem can often be solved by touching the sprue cutter briefly with a stick of bullet lubricant or other fluxing material. On occasion, bullets may be prevented from sticking in the moulds by the application of a tiny amount of lubricant. However, this is inclined to make the next bullet cast imperfectly and should be carefully watched. If you find it necessary to use force to free a cast bullet from one half of the mould, tap that block gently with a hardwood stick. Never strike it with any metal. Usually two or three gentle taps will cause it to drop free.

After the casting process has been completed, all sprue and defective bullets should be tossed back into the melting pot or otherwise laid aside. The writer has found that these small scraps which melt more readily than a large block are often extremely convenient to use the next time one begins casting. The bullet metal is either poured out into small pigs or permitted to solidify in the pot. In this case, sprue cuttings are useful in starting the melting process all over again. An iron ring or heavy screw eye is permitted to solidify into the mass, whereupon the slug can be lifted out and rehandled through insertion in a hot pot. A better method is to solidify the mass in the pot, empty it out, and throw a reasonable accumulation of sprue cuttings and defective bullets into the cold pot, whereupon the solid mass is replaced on top of it. When the pot is heated, the small fragments will melt readily, forming a puddle in the bottom which eats with surprising rapidity into the larger mass. I have found from actual experience that by starting the melting in this manner from three to five minutes can often be saved in the application of heat.

A word about casting hollow-point and hollow-base bullets. This job is by no means difficult, but takes more time. Hollow-point and hollow-base moulds are usually of the single variety, as it is enough work to handle the attachment without experimenting with one's inability to find more than two hands to use. There are a number of hollow-point and hollow-base attachments available, but the perfect design is not yet with us. The handloader who wants to go in for these cavity bullets will do well to read the literature of Bond, Belding & Mull, and Ideal, and then determine for himself just which type he thinks will be best.

The subject of flat *vs.* cavity-base bullets is discussed elsewhere. The chap who already has cavity-base moulds knows the problems they involve; to the beginner or advanced student who has not tried out these types, the author strongly suggests that it would be well for him to forget that part of the subject. Hollow-point bullets, however, are a horse of a different color. The hollow-point bullet is rapidly returning to the front in the shooting game, and every experimenter will sooner or later want to play with it. Most hollow-point attachments are practical, though slow, but good hollow-point bullets are well worth the added effort necessary to produce them.

Hollow-point bullets are usually cast with a base cut-off—the metal is poured from the base of the bullet. From the nose end, extending through the blocks, is a rod, separate from the blocks, which may or may not be adjustable for depth. The nose of this rod is ground to the final shape desired for the cavity. In use, one inserts the rod by means of a wood handle, or other holder, pours the metal, and then withdraws the rod before opening the blocks. Ordinarily there is nothing to hold the rod in position, but on a mould recently constructed for the author by George A. Hensley of San Diego, the problem has been nicely solved. The hollow-point attachment is turned with a stop-collar attached, said collar so formed that it does not permit the hollow-point form to enter the bullet cavity beyond a certain point. Half of this shoulder is milled off, and a set-screw, embedded in one of the blocks, prevents the attachment from dropping out when it is partially rotated so that the stop-shoulder slides beneath the screw head. This method of attachment is speedy in operation and minimizes the labor of casting, since it is not necessary to hold the cavity rod in position while the metal is being poured. Mr. Hensley uses this system on all of his hollow-point moulds.

Casting hollow-point and hollow-base bullets means added care in inspection, and all bullets with the slightest defect should be discarded if efficient results are to be obtained. Even minor

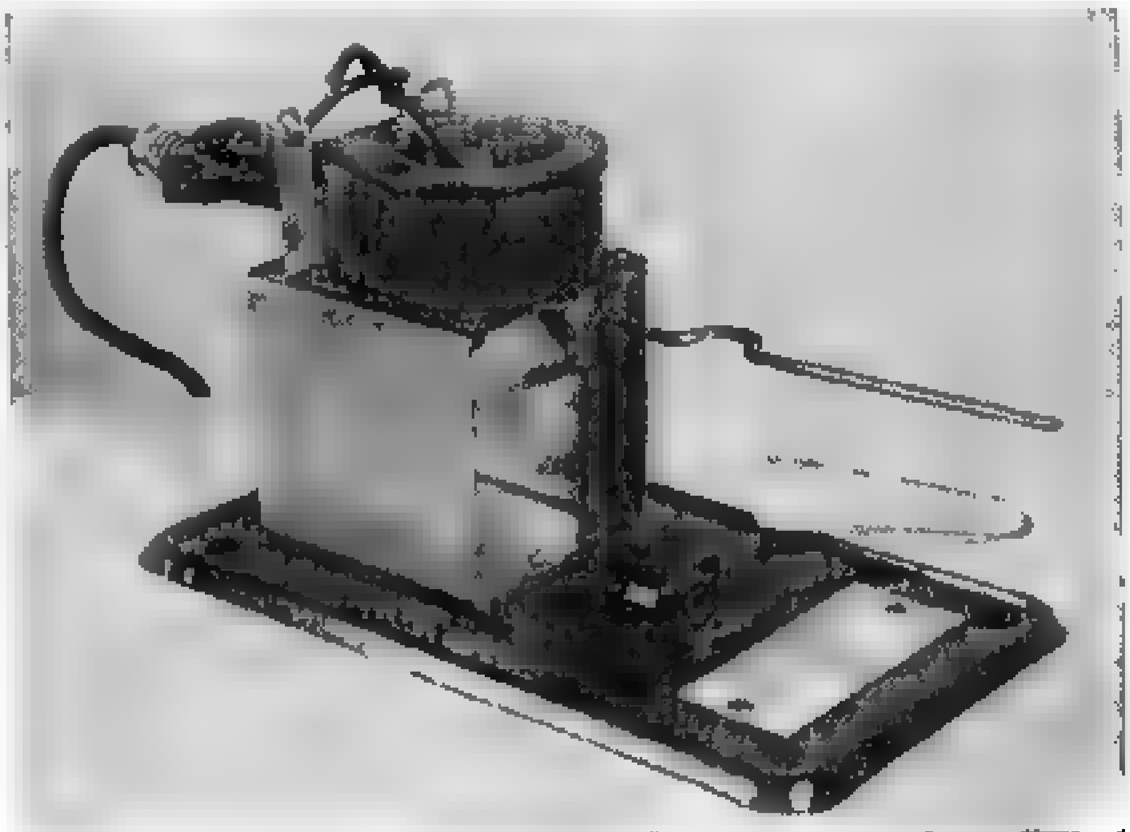
defects can completely destroy accuracy, and for hunting purposes only the finest of bullets should be tolerated. Throw back defectives for recasting. To begin right in the casting game, one must stress the inspection of one's product. Getting in the habit of doing things *right* is always wise in attempting handloading of ammunition.

Casting Machines. Walter H. Miller of 1132½ Tilghman Street, Allentown, Pa., brought out late in 1935 a little casting machine which is quite similar to a toy casting device known as the Gilbert Kaster. The Miller caster is a toy-like device which has done so well for the author that he has discontinued entirely all casting from the old pot and ladle. This new device is just the thing to speed up casting and make it less work. In use, it is almost essential that the bullet alloy be prepared in advance via the customary melting-pot system.

The alloy is handled more easily if poured in puddles on a concrete floor, then collected and stored for future remelting. The Miller casting machine has much too small a pot to permit of the blending of metals, and because of its design, it is difficult to skim the contents and free them of dross. Essentially this device is a small electric furnace mounted on an enameled metal base. The tiny melting pot has a diameter of two inches and a depth of 1¼ inches. It holds 3.9 cubic inches of metal, and since the average alloy runs about .4 pound per cubic inch, the pot will hold about 1½ pounds of metal. Since you can cast about 45 bullets weighing 150 grains with a pound of metal, it is only necessary to replenish the contents of the melting pot every fifty castings. A better way would be to add all the metal the pot will take every 25 bullets, thus insuring the proper melting of the metal without tying up the casting operation for a lengthy wait.

This tool is both clean to handle and extremely fast. My first attempt at casting with it was made in my office, the machine being set upon my typewriter desk with a folded bath towel beside it on which to drop the bullets. And what is more interesting, I did all the casting sitting down. The unit is extremely easy to handle—if you have the metal in chunks which will fit into the pot, you merely plug it into an electric outlet and wait. On one test I filled the pot entirely full, and when it had melted the current was shut off and the unit permitted to cool for three hours. A melting test was then run by plugging in and timing. Seven minutes and the solid chunk was ready to run into the mould. Since that time I have cast as many as 300 bullets at a single stretch, adding metal every 25 castings or so, and at no time have I had to wait for the additional metal to melt.

The pot has a valve which permits the metal to run through a snout of proper shape to fit the sprue cutter of a mould. With a slight amount of experience it is a simple matter to cast without spilling anything, and even at that spillage merely drops to the 11½ x 12½ inch base where it may be picked up to be returned to the pot. To operate, it is merely necessary to hold the mould so that the sprue cutter touches the pouring nozzle, raise an easily operated lever on the left side of the machine, hold it there two seconds, lower the lever —spring return takes care of this—and take the mould away. The sprue can be knocked off into a tray and the bullet dropped on the folded towel beside you.



A very useful tool for any handloader who desires to casts the Miller electric caster. Although small in appearance, it is clean, easy to handle, and much speedier than the old pot-and-ladle system

How fast is it? One half-hour test showed 136 bullets in .357 Magnum 160-grain weight. Inspection caused the rejection of the first three and the last two, the former due to improper mould temperature, the latter due to a nearly empty pot. Another test showed 235 in one hour, during which I knocked off to go down cellar after more metal. If all supplies are handy, there is no reason why the handloader cannot maintain an average speed of 250 per hour with a properly broken-in mould which drops the bullets without delay.

And the cost of operation? The unit draws 350 watts of electrical energy. In three hours it would consume about one kilowatt-hour. If you pay a high rate such as is stuck into the author in his locality, the power cost will be about seven to eight cents. This should give you at least 700 bullets—or about one cent per hundred. It is far more

expensive to cast over a gas range with the slower ladle and pot method.

If the experimenter desires to use a device of this nature without purchasing one already constructed, he might consider the Gilbert Kaster, a toy outfit designed for the home casting of lead soldiers. This is a similar machine with about the same size of pot and element. A few parts can be discarded, the pouring snout altered, and the proper shape constructed and brazed in place.

The most recent addition to the electric melting-pot family is the Potter casting machine, designed

Effective way of keeping bullet metal for use in the Miller caster

by Potter Engineering Co., 10 Albany St., Cazenovia, New York. Mr. Potter is also the designer and builder of the Potter handloading tool described elsewhere. This new Potter is similar to the Miller, but there are a number of improvements, among them being a large and a specially designed melting pot 2⅛ inches in diameter and 2 inches deep. The additional size of this unit gives it the capacity of 6.4 cubic inches, or about two pounds ten ounces of metal. It is built somewhat more sturdily than the Miller and its price is slightly higher. The consumption of electricity is very little more, if any. These machines are entirely practical for the work for which they are designed and are to be recommended if clean, uniform results are to be obtained. There are many legal restrictions against the sale of cast bullets, and it is advisable for the handloader to experiment with the art of casting his own. These machines greatly simplify the work and aid in producing highest quality of cast bullets.

For some months the author has been using this Potter caster with its larger pot size and greater capacity, and it is found that, with experience, about 500 bullets per hour can be thrown. The percentage of rejection due to imperfect casting is reduced to a minimum. With the Potter caster comes a special cast-iron ingot mould so that the handloader may blend his own bullet metal in some form of ordinary melting pot and cast into small pigs weighing about one-half pound each.

This cast-iron ingot mould will form six of these tiny pigs at a time, each one good for approximately twenty-five 150-grain castings. Accordingly, since the pot will hold approximately five of these pigs at a time, it is found by actual experience that once the pot contents are completely melted, one can throw about fifty bullets; he can then add two more pigs and continue his casting without waiting for the added metal to melt.

The most recent tests, conducted while this book was in press, consisted of continuous casting of 1000 bullets for the .357 Magnum, the job being done at one sitting, and requiring two hours and eighteen minutes. The author considers it excellent economy for the serious handloader to use one of these electric casting devices.

For the man who wishes to utilize a container capable of holding more than the customary electric units, the Merit Gunsight Company, 2276 Shattuck Avenue, Berkeley, California, has just released a new melting pot upon which patents are pending. This pot is entirely different from the ordinary type, although it is intended for use on a coal or gas stove. It can be equally well used with the usual plumbers' gasoline furnace.

This melting pot uses a pouring spout similar to those on the electric units, which greatly speeds the casting.

The pot has a special flat base having a flange so that it cannot be upset if handled with reasonable care. It is the result of two years of careful experimentation.

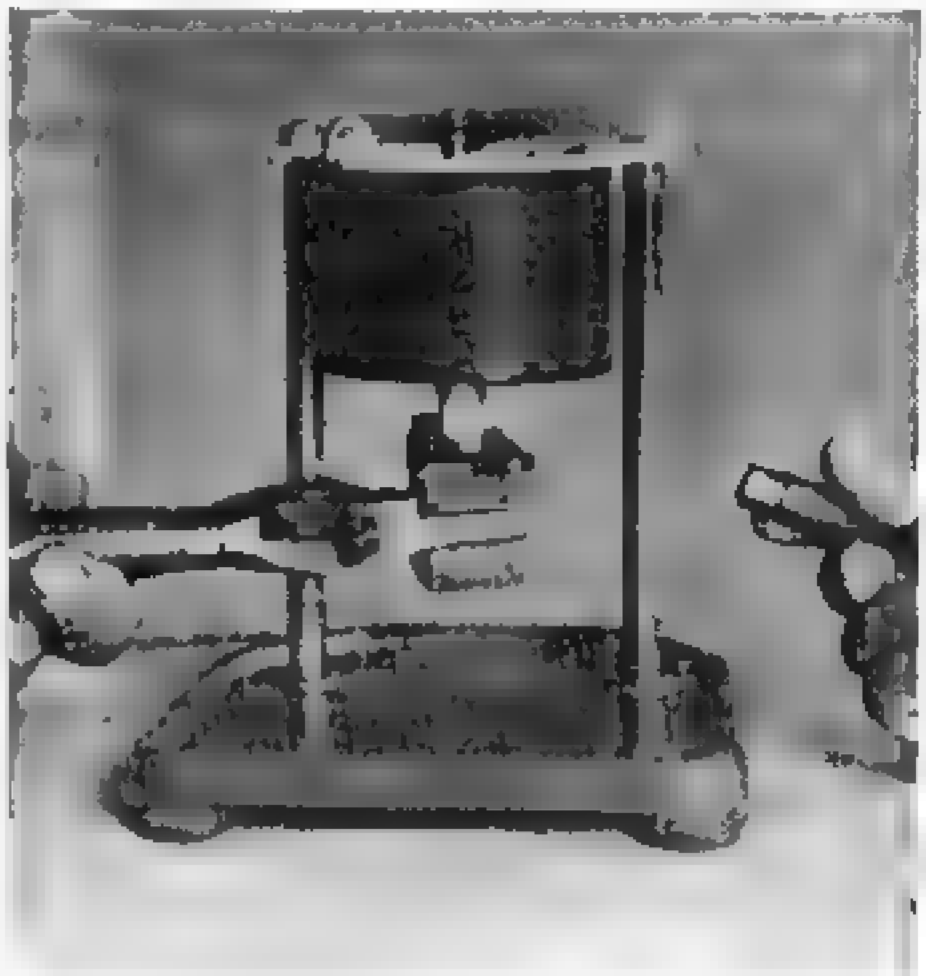
Outside of the flange base, this pot differs in a great many ways from the customary round-bottom unit. It is, of course, of gray cast iron, having an inside diameter of 5⅜ inches at the top and 4¾ inches at the bottom. The depth runs 3¼ inches.

A flange or flat table, forming a part of the base of this pot, is about 5¾ inches wide and forms an excellent "hot plate" upon which bullet moulds can be brought to operating temperature and maintained at that point when not in actual use. One merely lays the blocks on this shelf, thus keeping the handles away from the heat and at the same time avoiding burning blocks through overheating. The design of the unit is extremely interesting.

Instead of the customary round bottom or even flat bottom, this has a "step" cut into the interior. The liquid metal is drawn from the top of this step. It is thus impossible to drain the entire contents of the pot by means of a pouring spout. The

reason for this particular step cut is obvious to the intelligent handloader—it maintains a uniform body of metal to retain the heat at all times. It is therefore unnecessary for the handloader to cease casting when he desires to add metal, since he has a sufficient quantity in reserve to melt and blend the additional material.

The depth of this step being 1⅜ inches, material for casting the bullets is drawn from this level. The pot will hold about forty pounds of metal, and thanks to its design this quantity can be kept properly covered with charcoal to prevent oxidization and burning out of the tin.



The latest thing in a melting pot for bullet casting. The new Potter double-standard type, electric-power cord plugs into rear of melting pot. Standard electric-iron plug is used

In testing this unit we found it a simple matter to run 375 to 400 bullets per hour, using a single-cavity mould. There is one disadvantage. The pouring spout is approximately two inches from the cast-iron shelf, and this does not allow sufficient clearance for the average hollow-point attachment of bullet moulds. The chief advantage of this unit, therefore, lies in casting solid bullets; but for clubs and departments who desire to prepare only target loads, it would be ideal.

In use, this pot is very simple. After the metal is brought to operating temperature, one merely places the sprue cutter of the mould against the pouring spout and lifts the large wooden valve handle, holding it up for two or three seconds. It is then permitted to drop back into position of its own weight, thus shutting off the flow of the metal. There should be practically no spillage with this unit. We found it true in all tests.

Care of Moulds. When one has finished casting, the moulds should be cared for as carefully as any other handloading instrument. They should be permitted to cool slowly. Some operators cast the final bullet into the cavity and lay the mould aside to cool without operating the sprue cutter. They insist that this metal eliminates air from the mould and thus prevents any further damage, and quite possibly this would be extremely successful if the mould is to be laid away only for a short period. If one is doubtful as to whether or not he will need his mould again, a different treatment should be resorted to.

Any form of bullet lubricant can be used to grease the blocks thoroughly while they are still warm. A drop of oil should be applied to the hinge pins and to other moving parts. With the blocks still warm, either oil or grease should be lightly applied to the moulds on their operating faces and on the outside. An oily rag, preferably of wool, should be wrapped loosely around these blocks to exclude dust and dirt, whereupon they can be laid aside with reasonable assurance that they will be in proper condition when occasion demands them.

This problem of lubricating a mould also creates its sequel—removal of the grease when the mould is next brought into service. There are two ways of doing this. If the blocks are inserted in furiously boiling water and held there for a few moments, the action will free most of the grease from the operating surfaces, thus eliminating much of the problem of defective bullets in the early castings. Some operators use, instead, an application of gasoline either with rag or brush. Either method is satisfactory. It is occasionally useful to place a drop of oil on the hinge and sprue-cutter pin or screw for easy operation, hot or cold. Lubricated or dry, any bullet mould is far more delicate than its manufacturers like to indicate. The

beginner may spoil an occasional mould. The skilled operator knows the necessity of extreme care.

The storage of these moulds is always a matter of considerable interest to the handloader. There should be a place for each individual mould and it should be promptly returned to its proper place immediately after using. Cabinets, shelves, and other similar storage facilities are desirable, and one of the best methods of storage is to wrap the mould in heavy waxed paper and return it to its original box. If this box is not available, or if it is desired to store all moulds in similar sizes and shapes of boxes, a near-by cigar store will supply you with all the cigar boxes you wish. These can be stacked and the contents labeled on the end of each. The energetic handloader will find it convenient to gather in a plentiful supply of these boxes—they can be used for a multitude of practical purposes.

H. E. Lacy, President of Helmco, Inc., of 844 West Jackson Boulevard, Chicago, recently developed an accessory for the handloader which is well worthy of consideration.

Mr. Lacy is an active handloader as well as a business man and appreciates the problems of the handloading fan. The development began purely for his own personal satisfaction and consists of special bullet trays for the storage of cast bullets, either before or after lubrication. These trays were originally made of aluminum, but Mr. Lacy experimented with spun steel in the larger sizes and decided to adopt these. At the author's suggestion, he discontinued the aluminum trays in smaller sizes, so that the entire set is now available in steel.

These steel trays are absolutely smooth inside and out, which permits of easy stacking on a shelf and perfect protection against dust and dirt. They are made in 6, 9 and 11½ inches diameter inside, and all are 1¼ inches high. This permits bullets to be stacked neatly on their bases, and a snug but not too tightly fitting pressed-steel cover slips over the entire unit to keep out dirt. Steel trays are superior to aluminum in that they can be washed free of any accumulation of grease and are not inclined to scratch. Aluminum trays will pick up dirt and débris in the scratches and do not wear as well.

A sample of the 13-inch tray in my possession is made out of somewhat lighter steel than is now being used and weighs 1 pound 12 ounces. The 9-inch size weighs likewise, due to heavier stock. An earlier sample in this size weighs 1 pound 2 ounces. The 6-inch size is made of the same weight of stock as the heavy 9-inch size and weighs 12 ounces. We recommend the use of the 11½- and 6-inch sizes in preference to the larger numbers. These trays, of course, are circular and stack neatly, without tendency to slide or tip over. They are reasonably priced and, because of their construction, should last the handloader permanently.

Incidentally, it might be well to mention that all metal articles that are wiped free of oil and grease can be written upon with a standard "China Marking" pencil, available at any stationery store. These pencils cost a dime each and are available in an assortment of colors. The two most practical types are red and black. These can be used to write upon glass bottles, powder canisters, cellophane, and other articles which will not take ink or ordinary pencil. There should be no excuse for the handloader to have unlabeled materials around if he keeps one or two of these pencils on hand. To erase any writing, it is merely necessary to rub with a clean cloth.

IX

BULLET SIZING AND LUBRICATING

BULLETS, as they come from the mould, are more or less certain to have a few minor defects. Should the mould blocks fail to close tightly, there will be a looseness in the joint at the time of pouring and the result will be a tiny "fin" on the finished casting. Also certain moulds tend to expand or warp slightly as they are heated, resulting in the casting of oval bullets. Oval bullets are far more common than many realize; you can readily verify the statement if you will carefully "mike" a half-dozen bullets chosen at random from your next group of castings. The time-honored method of overcoming these defects is to resize the bullets—in other words, push them through a die or hole in a block of metal of predetermined size, and thus force them into shape for the final operation of loading and firing.

At the same time it is vital that every lead or lead-alloy bullet be coated with some form of lubricant to make sure that the major portion of the projectile will get through the barrel and start off in the direction desired with a minimum loss in weight and general contour.

What an Unlubricated Bullet Does to a Gun. An unlubricated bullet is a source of unpleasant surprise to the shooter, and contrary to the lectures offered by authorities on the subject of handloading, the author suggests that every beginner load up ten of his perfect castings, properly resized, *but absolutely free of lubricant,* take them to the nearest place where he can shoot in comfort, rest his rifle or revolver to get the best possible accuracy out of his loadings, and then shoot them at a paper target, aiming each shot with the greatest of care. Then he should go home. He should not attempt to do any more shooting with that gun that day. Ten shots are enough. Note the terrible condition of the target. Note the poor accuracy; the tendency of certain shots to keyhole; the inability of the shooter to hit anything or to shoot a reasonable group.

This suggestion is for beginners. The experienced shot will understand the results of such shooting.

When you get that gun home, look through the barrel. Note the heavy metal fouling, or "leading" as it is properly called. Run a rag through the barrel and note the tough, patchy masses which stubbornly refuse to part company with the steel. Let us understand just exactly what happened. It's really quite simple. You merely soldered the interior of the bore. Soldered? Certainly. The best of hard solder is fifty-fifty—equal parts of lead and tin. Plumbers' solder runs 40-60 or even 30-70; in other words, from three parts of lead to two of tin down to the soft solder of three parts tin to seven of lead.

Before you can solder a joint, you must clean it up and make it bright. You then tin it by fluxing it lightly with some sort of rosin or soldering paste or acid, whereupon you heat the parts with a soldering copper, touch them with solder which runs where it was fluxed, and a certain amount of the tin contents adheres to the metal, forming a base to which the remainder of the melted lead-tin alloy called solder may affix itself. In the bore of your gun a very similar action takes place. The bullet of solder is pushed through a rifled tube at a very high rate of speed, thus causing sufficient friction to heat up both the barrel and bullet. Thus, even without soldering flux, the semi-melted surface of the bullet is soldered to the bore and torn off the projectile. Succeeding bullets build up the leading, and each accumulated spot reduces the size of the interior. Each bullet, therefore, is forced to squeeze through a "ragged hole in the fence" instead of a smooth doorway, and it emerges from the muzzle badly battered and with pieces torn off and left hanging on the inside of the barrel. Some spots of leading are torn loose with each shot, only to be "tramped down" in another part of the bore.

Lubrication tends to reduce friction to a minimum, thus lowering bullet and barrel temperature, forming a protective film on the rifling and speeding up the fraction of a second the bullet remains in the barrel. It has always been necessary since the beginning of rifling. Grease, oil, tallow, or even saliva have been used, but the naked lead bullet has never been successfully shot from a rifled tube.

Why do I suggest that the beginner deliberately attempt the stunt frowned upon by all experienced handloaders? Because it is comparatively safe, and the handloader who once performs this ex-

periment will never repeat it. He will learn exactly what a single string of ten unlubricated shots can do to a barrel. He will be able to learn promptly just what a leaded barrel can do to the accuracy of a bullet. And he will have on his hands an excellent job in the problem of lead removal. He will have an opportunity of testing out the "lead removal" qualities of various powder solvents on the market which rarely do as their makers claim, despite the long list of recommendations. He will learn that there is but one real way to remove leading—with a wire brush and elbow grease. And having learned by experience, who can say he will not be the wiser?

It is well to create artificially a case of leading that the experimenter may have an opportunity of studying its cause and discovering good methods of removal. As he develops new handloads, he will find that certain bullet alloys, particularly if too soft, create leading problems which must be solved. He will do well to learn early in the game how to cope with a bad dose of leading. Of course, if he wants to try the effective and time-honored stunt of plugging up the barrel and pouring in an ounce or so of quicksilver (mercury) and rolling it from muzzle to breech while the barrel is kept stoppered up, he will find that lead removal is comparatively simple when tackled in this fashion. He will learn that oils and greases from powder solvents which have been used on that leading have given it a protective film, so that it doesn't come out quite as easily, even with mercury, as has been claimed for the old stand-by. And then he will scrub his leaded barrel out with hot water before trying the mercury, and will learn that lead amalgamates with the heavy liquid.

Having learned first-hand the very important fact that bullets MUST be lubricated if they are of the ordinary lead alloy types, he is better qualified to tackle the problem.

Early Experiments. The author recalls quite vividly some of the reloading experiences of his youth. That first loading tool, an Ideal with attached bullet mould and non-adjustable loading chamber in the .38 Long Colt caliber, provided much delightful experimental work. He soon abandoned the .38 Long Colt shell in favor of the Special after learning that with care the longer cases could be properly crimped. Ideal lubricant seemed rather expensive to a youngster in those days, so we borrowed some vaseline from the family medicine chest. That was a memorable stunt. The vaseline permitted the lubrication of the bullets with the fingers in less time than the harder greases. But—

Came the acid test of this game—shooting. A week after a batch had been loaded, we tried them out in the company of one E. C. Dyer, fellow experimenter of pre-high-school days. That same co-conspirator is still alive and active in the game, conducting much of the experimental work recounted in this book. As a technician, Mr. Dyer has been continuously associated with the author for more than twenty years, and from our youth he has never considered an unsuccessful experiment completed until the reason for its failure had been analyzed.

On that day the pair of us sallied forth from the city to do our customary "plinking." The first shot was a surprise. The bullet failed to leave the barrel. A pencil was called into use, the cylinder swung aside, and the pencil pushed through the barrel to extract the bullet. It came out easily. The next shot sounded sick and the bullet struck the ground in front of the standard U.S.R.A. 20-yard target on which we were chiseling some three or four yards of distance. A third shot was somewhat better, but still rather weak in spirit. Yet that load was a normal full charge consisting of 3.5 grains of Laflin & Rand Bullseye. Dyer, who years before that had acquired the nickname of "Obie," insisted on an immediate autopsy. First a cartridge was dissected. Then the three fired cases were given a minute inspection. Lastly, the bore of that Smith & Wesson Military and Police was given a careful examination.

The truth will out. The vaseline had melted and run down into the case, thus coating the powder grains with oil which absolutely prevented their ignition by the primer flash. In the dud shot which failed to get the bullet out of the barrel, most of the powder charge, in a gooey mass, was blown out of the shell without igniting. The remainder of that day was spent in burning up the 200 rounds of ammunition we had loaded. Two guns were used, and we had a half-dozen misfires, while no less than ten bullets stuck in the barrel. We shot them only to recover the cases.

Obie was not satisfied. He suggested that it might be well to learn whether or not vaseline began to run immediately, and since the previous shells had been loaded a week, we tried again. Twenty-five loads were assembled with vaseline-lubricated bullets, dumped into the author's pocket, and on a hot day we set forth. The bullets had been loaded only half an hour before we left. In an hour they were in the gun and being burned up. Results—about the same. Vaseline as a lubricant was out.

We tried various forms of cup grease with simi-

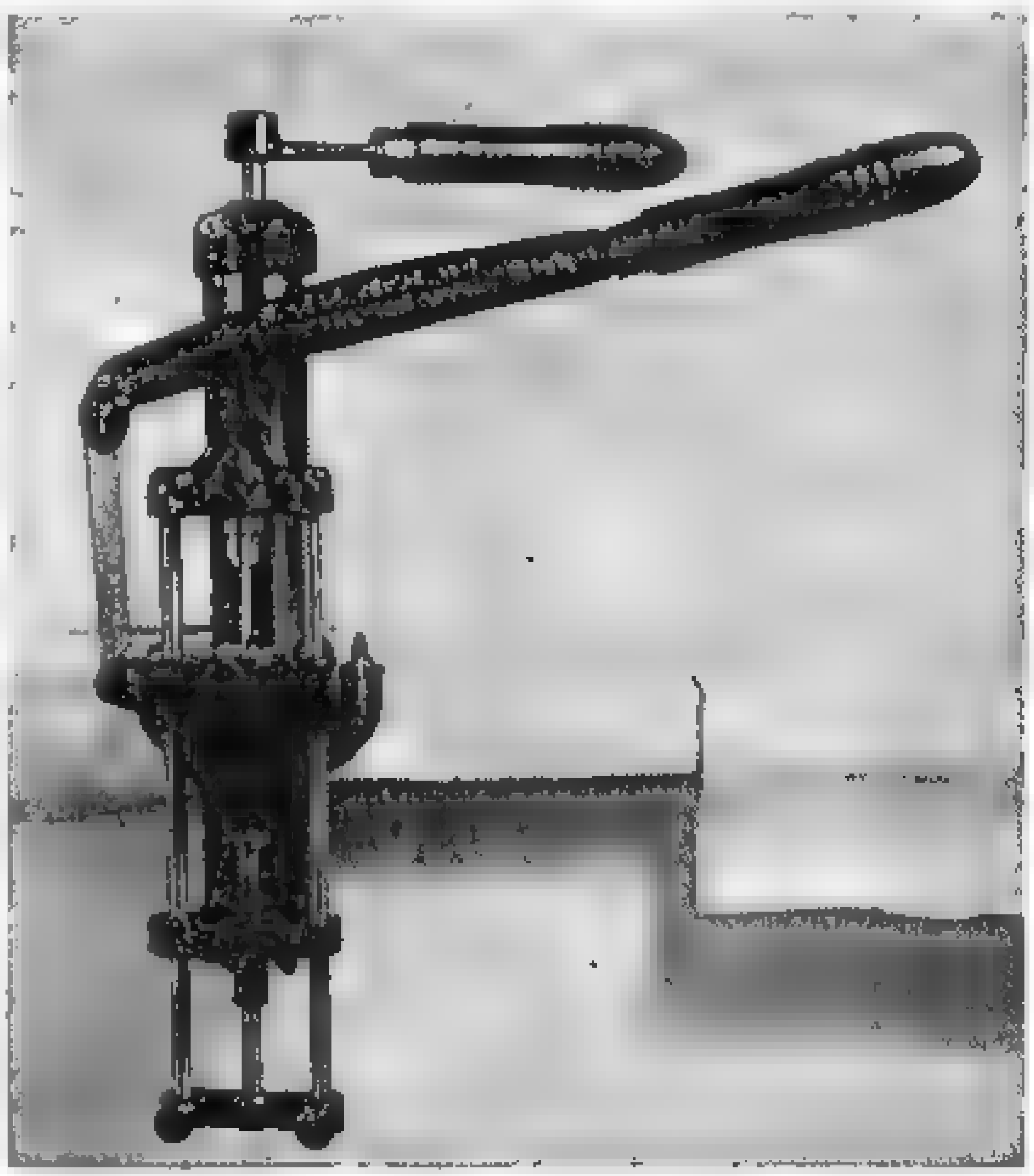
lar results. Regardless of the form of grease, it ran in revolver loadings and killed the powder. Occasionally it ran back enough to kill the primer and a misfire resulted. In recent years, however, we tried, with reasonable success, some of the waterproof cup grease known as Kasson's. In the manual of a newly purchased car were instructions telling us to use this grease only in the water-pump grease cup. We found that it was obtainable only in a pound can, and that a pound would be good at normal rates of consumption for about ten years' car service. So we tried this lubricant for bullets. It did not run, and worked fully as well as some of the prepared formulas which cost ten times as much. To the experimenter who wants to try it, I suggest that he visit his nearest "one stop" lubrication station and ask the operator for a small amount—a tablespoonful. He will usually get it for the asking.

Pioneer Lubricants. Early handloaders, without the facilities of modern civilization, used animal fats, but it must be borne in mind that any animal fat will rot as will meat. If any form of animal grease is used, it must not be applied to bullets which are to be stored, either loaded or unloaded.

Pure Japan wax is excellent, but it must be combined with other materials for best results. The so-called Japan wax is a vegetable compound made from the Carnauba Palm tree of *South America*. Japan imports the wax-like oil exuded by this tree and turns it into a hard wax which she uses in candles and in both raw and chemically pure wax for export. Although it is excellent in its pure state, it still is a bit too hard for use in other than a pressure machine like the Ideal, Bond or Star. During the period when the Government loaded the lead-bullet gallery loads for the Springfield—shortly after the World War—pure Japan wax was used. Many factories also use this on their lead-alloy handgun and low-power rifle bullets.

Winchester used this wax for years, and it is well to point out that Winchester does not copper-plate many of its lead bullets as do some other makers. Japan wax, therefore, is quite satisfactory. A few years ago the author had Winchester build 2000 bullets in .38 Colt Special and a similar quantity in .44 S. & W. Special for experimental work. He arranged to have Winchester copper-plate these bullets, and the factory apparently used pure Japan wax as a lubricant. For a while this worked well, but corrosion soon set in and the white wax turned green. After some 500 bullets had been used, it proved necessary to soak the bullets in gasoline to soften this combination of grease and verdegris, wipe all softened lubricant from the grooves individually and by hand, and relubricate by forcing them through a lubricating and sizing press.

There are some long-established formulas for bullet lubricant mixtures which have for many years withstood the test of time. Among these is the famous Niedner mixture, readily compounded at home with materials which may be purchased through your local drug stores. To a half-pound of melted Japan wax add four heaping teaspoons of powdered Acheson's graphite #1340. The



The old familiar Ideal sizer and lubricator

melted mixture must not be too hot, and the graphite must be added a little at a time and stirred continuously. When the entire amount has been added, remove the mixture from the heat supply, and *continue the stirring*. This is very important. If left to stand in a melted mixture, the graphite will separate from the wax. Stir until the mixture has solidified to the point where stirring is impossible, whereupon it is well to scrape the entire mass from the melting pot to a clean surface such as a loose pane of window glass laid on a table, and the mass kneaded thoroughly in the hands. It is now ready for use, but its chief value is for pressure lubricating machines, since any reheating will cause the graphite to separate.

The famous Herrick mixture, introduced more than twenty years ago, contains equal parts of beeswax and Japan wax with a small quantity of cylinder oil or castor oil, the latter added primarily to soften the mass. The exact amount of oil to be

added should be determined by experiment, but the smallest possible amount should be used. The oil will "sweat out" if lubricated bullets or loaded cartridges are stored for several months.

Mattern, in the reloading series published in *Arms and the Man* and *The American Rifleman* in 1922 and 1923, recommends a mixture of mobilubricant or cup grease, with 10 per cent by weight of graphite, and a small quantity of beeswax, Japan wax or paraffin added to stiffen. After early experience with vaseline and such mineral oils, however, we abandoned this, and have never tried out this formula, although it would probably work well if used carefully.

Some users of old-time rifles insist on using wads of grease beneath the bullet to act as a lubricant, particularly when using black, Lesmok or semi-smokeless powders. The author tried this stunt some fifteen years ago and experimented at length to determine a good method of forming the wads, all without success until Mattern burst forth with the solution in his early loading series. Minor improvements on the Mattern system were made in order to simplify the process and permit of storage. First, the wax lubricant is melted, and a quart milk bottle of the plain type is filled with cold water and dipped into the melted mixture, bottom down. When withdrawn immediately, a coating of wax adheres to the glass. If desired, it can again be dipped to build up the wax to the desired thickness.

For speed work a half-dozen bottles are used, the water poured out and the bottles inverted to protect the wax. When all six bottles are coated, the operator picks up the first and slits through the wax on one side, slipping the "cast" from the bottle. Pouring out the water will usually cause the wax to remain soft and flexible, thus enabling the operator to handle it. Should it stiffen too much, the bottle can be filled with *warm* water—not hot—and held in the hand a moment. As the temperature of the glass rises, the wax will soften.

The stripped casting should be cut and folded into flat sheets and "ironed" by placing on a strip of waxed paper—bread wrappers will do—with a similar sheet over it. Gentle rubbing with the hands will smooth the sheet. Bulges, thick spots around corners and where the wax ran, should be cut out and thrown back into the pot. The flat sheets of varying sizes should be stored in a cool place between the layers of waxed paper until they are needed for use, whereupon the handloader will find that they are convenient to handle and prepare.

Loading Wax Wads. Loading the wax wads calls for a slight softening of the sheets by placing them in the sun for a few moments. The shell, filled with powder, is then placed mouth up and a sheet of wax held over it. A gentle pressure with the thumb cuts a wad with the shell being loaded, slightly "dishing" it into the shell. The bullet is then started with the fingers and forced home, crimped or left uncrimped, with the bullet seater. Surplus wax left over is rolled into a ball and tossed in with the reserve supply, or the ball added to the contents of the storage chamber of a lubricating machine. There is no waste.

Some of the riflemen of today use wax wads with high-velocity metal-case bullets. I have tried these with the .220 Swift and .257 Roberts cartridges and find that they not only improve accuracy, but practically eliminate erosion when light bullets are driven at velocities above 4000 f.s. This feature alone warrants their use. Harvey Donaldson, of Fultonville, N. Y., desiring to use a wax wad with a heavy graphite content, discovered that one of the "Alemite" high-pressure grease guns could be rebuilt with a special nozzle to turn out ribbon about ¾ inch wide. J. Bushnell Smith of Middlebury, Vt., of Smith's Custom Loads, reports that the graphite wax wads have proved extremely popular in his Swift loads custom-built for his many customers. He finds that they are worth the additional effort necessary to make them. Instead of a handgun, however, he uses a special type he has built for himself to use in his heavy arbor press. The average home loader, however, will find that the altered Alemite gun will do the trick well.

One afternoon when the author was assembling some loads with wax wads, Major N. H. Roberts, designer of the .25 and .257 Roberts cartridges, dropped in for a visit. "Wax wads," said Ned, "are by no means new. I've used them very extensively. Dr. Mann used them as early as 1908, and so did Adolph Niedner. When Dr. Mann died, his wife destroyed the manuscript of his unpublished second volume of *The Bullet's Flight from Powder to Target,* and I know that it contained the results of years of his research on the subject of wax-wad lubrication. The earliest reference I can find to the use of wax wads is in a treatise on flintlocks published in 1780. . . ."

Wax wads do not work well unless they remain in the neck of the cartridge. Thus one must be used only behind a bullet which, when seated to operating depth, does not project into the case body. These wads are also useful with old black-powder cartridges, particularly the long straight shells. Winchester and UMC at one time loaded

the Sharps .40/70 and .40/90 with wax- and waxed-card wads. And the late Edward A. Leopold, of Norristown, Pa., noted rifleman and designer of many bullets in the Ideal line as well as creator of the formula for Ideal bullet lubricant, made and sold to riflemen a wax wad known as "Leopold's Oleo Wads." The original Leopold formula for grease wads called for 5 oz. Japan wax, 5 oz. beeswax, 2 oz. ozocerite (also called "ozokerite"), 3 or 4 teaspoonfuls Acheson Unctious Graphite #1340. N. H. Roberts uses this formula today in all his grease-wad loadings and finds it superior to resin-containing mixtures. Resin is a poor material for the inside of rifle barrels, and if used at all, must be used sparingly. It is *not* a lubricant in itself—rather it works the opposite way.

Formula for Wax Wads. What is the best formula for wads? Here is Donaldson's mixture: 2 oz. rosin, 4 oz. beeswax, 3 oz. Japan wax, 2 oz. tallow, and 2 oz. #38 grade Acheson Unctious Graphite. This mixture may be softened, if desired, by cutting down an ounce or so on the Japan wax or by adding more tallow. Smith uses straight beeswax and graphite and gets exceptional results. I use both formulas and can see little difference in their performance. Neither gives trouble in extremes of hot and cold weather. Major Roberts makes his wads of six ounces ozocerite, one ounce graphite and two ounces beeswax. This performs excellently but is much stiffer than the other mixtures, and in using it the author adds two or three ounces of tallow and an additional ounce of graphite. The Smith and Donaldson formulas are "graphite wads." The Roberts mixture is for "wax wads."

The pioneers who did much of the experimental development work on the .220 Swift cartridge—J. B. Sweany of Winters, California, and the late G. L. Wotkyns, also of California—have long been experimenting with the problem of grease wads. These two experimenters have given bullets a velocity much greater than the standard .220 Swift loads, and one of the early problems they had to overcome in developing more than thirty different types and shapes of .22 cartridge cases, was the problem of erosion. They found that grease wads were a great help in reducing this ever-present problem of the super-high-velocity cartridge. Sweany, with whom the writer has been in constant contact since his first affiliation with the project, writes that "all Swift loads require grease wads for best results, both in reducing erosion and producing maximum accuracy."

The Wotkyns and Sweany formula which I have experimented with at length is made as follows: 1 pound beeswax, 4 ounces microfine graphite, and 4 ounces castor oil. This is an easy combination to make, and being vegetable in the grease, unites readily besides being highly heat-resistant. Those who have tried this formula at my suggestion have found that castor oil blends more easily with the beeswax than mineral oil. A quantity of this material which I have had lying around for a year gives no indication of "sweating" any of the oil out of it. Some other formulas do not seem to fare quite so well, although the majority of grease-wad formulas are highly practical for use within a reasonable length of time and under reasonably cool storage conditions.

In addition to the above-mentioned formulas for home preparation of graphite wads, the Industrial Products Company, P. O. Box 14, Wakefield, Mass., is supplying to handloaders a specially prepared graphite-wad ribbon which appears to be excellent in performance. The Donaldson formula, less the rosin, is used in the "standard" formula.

This grease-wad problem has got a number of the boys experimenting. In playing with it I secured the cooperation of the late W. A. Lamb of the Industrial Products Company, who prepared numerous formulas for experimental work. Tests were conducted under varying conditions, and the Massachusetts Institute of Technology asked to cooperate by refrigerating certain grease-wad samples in an effort to determine the effect of cold weather on wads. This experimental work is still under way at this writing. It was suggested when a rifleman explained that, since he had enjoyed excellent success with grease wads in his target rifles, he would like to load his hunting ammunition the same way, but had some doubts because the temperature frequently drops to fifteen below zero in his hunting country.

Some of the most practical grease-wad formulas, we found, contained colloidal graphite. Colloidal graphite, being much finer than the dry or powdered variety, is more inclined to penetrate the pores of the barrel metal under the pressures developed during firing, thus sealing these pores and greatly reducing wear on the barrel. The wad now being marketed for sale by the Industrial Products is known as the "Sharpe Colloidal #2," and the formula calls for 4 grams of Oildag, 2 grams of castor oil, 4 grams of beeswax, 12 grams of Japan wax, and 1 gram of petrolatum. Notice the absence of resinous material. This wad is excellent for either summer or winter use, although for extreme summer heat the quantity of beeswax

should be increased to about seven grams in the above formula.

Wad Erosion. In the April 1937 issue of *The American Rifleman,* my good friend, Elmer Keith, had an excellent article on experimental research with a magnum .25 caliber, eventually named the .250 O'Neil Magnum. Elmer recounts a great deal of his experimental research along these lines, particularly with regard to barrel life.

A very practical bullet sizer for the man who does not care for an expensive machine. The bullet is first lubricated by some process similar to dipping, dropped into the top of this sizer, and then shoved through with the plunger, base first

In his excellent data, Keith indicates that one barrel shot without any grease wad gave a life of approximately 700 rounds and still gives good accuracy, while another quit cold at 250 rounds when graphite wads were used exclusively. To the author's way of thinking, however, the answer to his barrel life is contained in the previous paragraph of his article, in which he states: *"Having heard so much about the Donaldson Formula Graphite Wads and having had fine success with these in my .22/4000 Schmitt, heavy barrel rifle, I determined to use them altogether. . . ."* The Donaldson formula, as described in a preceding paragraph, contains rosin. Rosin is abrasive, a friction-producing material, and has absolutely no proper place in the inside of a rifle barrel. Under the tremendously high chamber temperatures during ignition, rosin becomes hard, brittle and abrasive, and is itself just like a blast of powdered glass being blown up the barrel. Naturally, erosion occurs. This would indicate quite clearly that rosin will reduce barrel life when introduced into wads.

Just what use does rosin have in wads?

In two visits in successive years, I spent much time arguing this matter with my good friend, Donaldson, who endeavored to convince me of the value of rosin. He insisted that it enabled the grease wad to cling better to the case neck. Having used approximately twenty different formulas for grease wads to date, I find that the majority of them, if properly made, will cling to the case neck and give no trouble whatever, and that performance is just as reliable where rosin is not used.

The most important feature of the use of grease wads is increased barrel life, and a properly made wad will so perform. Before the .220 Swift appeared on the market, but as soon as chamber dimensions were standardized, I had my friend J. B. Sweany, of Winters, California, make up a special job using a heavy Winchester barrel blank mounted on a new Springfield action. This particular test gun has been used continuously with all kinds of loads, and has seen nearly 3000 shots at the present time. It will still do one-inch groups at 100 yards, and while there may possibly be erosion in the barrel, it is not visible to the naked eye. Approximately 500 rounds of factory ammunition have been shot through this barrel, the remainder being handloads and every handload with a grease wad.

The important difference in grease wads used by the author is that the colloidal graphite formula developed as above mentioned is used. Colloidal graphite wads, as made by Mr. Lamb, contain no rosin whatever, nor do they contain any abrasive material. While powdered graphite can be made abrasive under action of heat, colloidal graphite cannot, and since it is electrically charged at the time of manufacture, it cannot coagulate and become lumpy, even after extended periods of standing in its original solution. Colloidal graphite particles are sufficiently fine to go through filter paper. Therefore, they will penetrate the pores of the steel and give more or less protection to the inside of the barrel proper.

This wad material costs but slightly more than the standard formula and is, to the author's way of thinking, well worth the added cost. It would be extremely interesting if Keith conducted another barrel-life test using one of these super-

velocity O'Neil Magnums and with colloidal graphite wads exclusively. If he desires to undertake this, the author will be glad indeed to supply the necessary wad material for the experimental work. There is a great deal we do not know about erosion and grease wads; as a matter of fact, there is much to be learned regarding both interior and exterior ballistics at the present time. This generation will never see the solution of such problems.

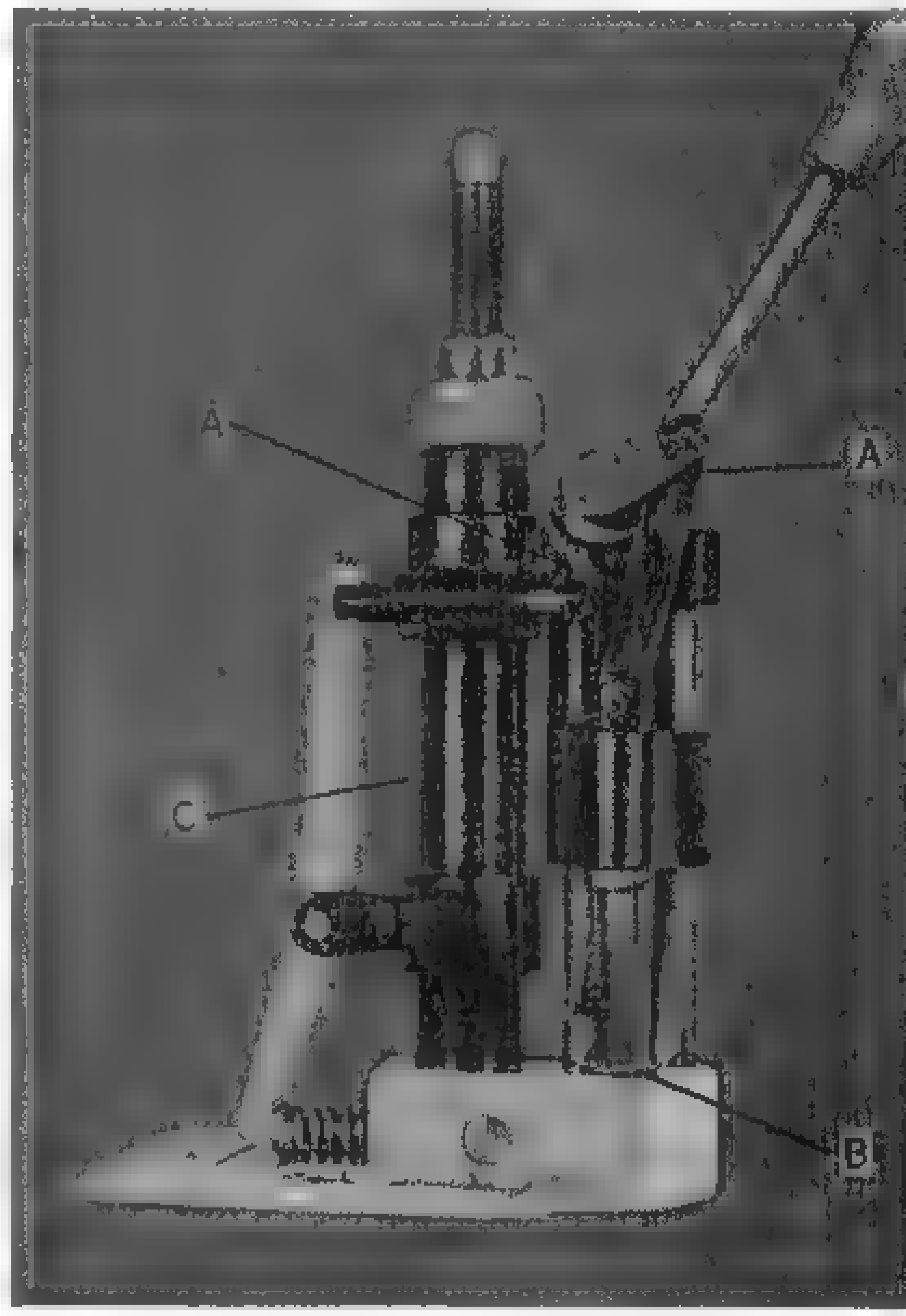
The Bottle Method. The author is indebted to R. R. Sherman of McLean, Va., for information concerning his development of a method of making wax sheets for grease wads by means of the bottle method and doing it in a way that makes it commercially possible to produce them in quantities for marketing. I asked Mr. Sherman to describe his system of forming these sheets, and his reply is sufficiently informative to quote.

"Melt all waxes, tallow and rosin together," he writes. "When melted, add and stir in graphite. When thoroughly mixed, let cool, but stir occasionally. The *cooler* this material becomes without congealing, the easier to handle and make the sheets. THIS IS TRICK #1. I even let it cool to the extent that it begins to congeal slightly along the sides of the container (only slight heat is required to bring it again to the liquid state or place container in warm or hot water to maintain even temperature). I keep it stirred while making sheets to avoid any possibility of the graphite settling; thus it remains in suspension easily.

"TRICK #2. I fill my bottles or jars with cold water and at times add cracked ice to the water, which makes it colder and keeps the water colder for a longer period without changing it. Of course, put on the tops to avoid spilling. By the way, I use one-half gallon bootleg liquor jars, of which there are plenty around this section, as they are four-sided and make excellent sheets. Using these jars avoids the necessity of warming sheets made with a bottle to press out flat. *Thoroughly* clean off outside of bottle or jar with cloth dampened in kerosene (gasoline might also work). This procedure seems to clean the glass thoroughly, and water will easily adhere to or remain on the glass. I then set the jars or bottles in a pan of cold water to avoid any possibility of their picking up dirt or grit. Before I use them to dip, I *wet them thoroughly with a very wet cloth and water.* The use of water is better than coating the jars with a light oil; it has that method beaten a mile and then some.

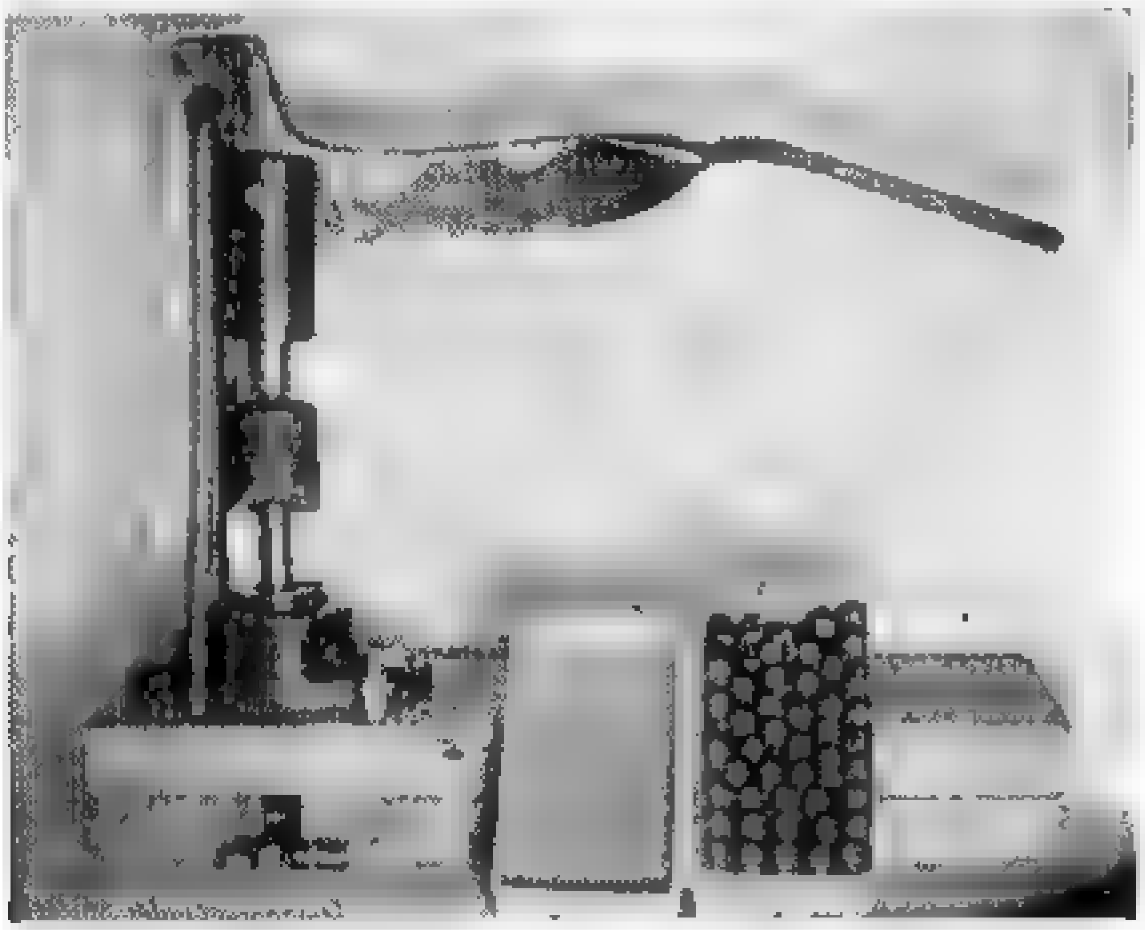
"Dip the jar in the melted material, let it rest a second or so, then raise it and let the surplus material drain (you will notice the wax appearing to dry out); then dip again to make sheet the required thickness. The cooler the material, the thicker the coating will get at each dip and the less dips will be required; besides, the water in the jar will stay cool longer. When dipped often enough to suit, scrape surplus off bottom with flat-edged stick, then make cut from top to bottom down through the wax and set aside on waxed paper or in water for further cooling. In a few minutes I raise the jar, and nearly always the sheet drops away from the jar. (Making the cut as stated offsets the tendency for the wad to crack when it contracts from cooling; for the crack, like everything else, comes where you do not want it and will require trimming and extra work.)

"I then wet jars again and dip some more. If



The fastest sizer and lubricator on the market, the Star, developed in 1934. The operating toggle "A" forces bullets into the die "B" ready for the lubricant. The toggle at the point marked "A" contacts a plunger at the bottom of the stroke, thus causing the grease ram arm backed by the spring to force grease into the grooves of the bullet while it remains in the die. The main cylinder "C" is kept full of grease and the plunger is tightened with a wrench on the top about every 100 bullets

wax sticks at any part—and this will often happen—run a knife blade under the sheets, and cut loose; then wipe jars off again with kerosene rag, and always wet before each new dipping. Any water remaining on the sheet is easily shaken off. Trim up sheets to suit, and throw surplus or waste back in container for remelting. I use a container a little larger than the jar or bottle that I am going to dip with, and for the half-gallon jars I use a one-gallon oyster pail; for small bottles I use a tomato can. I often make up from three to five



Homemade bullet swedging or resizing tool made by A. J. Weing of Golden, Colorado, in part from the Belding & Mull bullet resizer. The side is cut from the die to permit easy insertion of bullets. This tool will resize metal-cased bullets readily

pounds of sheets in one hour—if I don't get reckless and bust a jar; then I make things warm when I get all wet. If the wax sticks, the jars are not clean, or they have not been wet thoroughly with water."

An excellent straight bullet-lubricant formula used by yester-year's riflemen consisted of three parts of beeswax and two parts of heavy cylinder oil. Like other mineral-oil formulas, this mixture should be melted and stirred until all ingredients blend thoroughly. It should then be used within a few days and never left in loaded cartridges. After a few weeks of storage the oil will sweat out of the hard wax and leak back to kill the powder charge and primer. This mixture was popular with those riflemen who used their lubricated bullets for range loading or seating direct into the chamber. For fixed ammunition it worked best when promptly loaded and fired. If you keep a supply of the mixture on hand—or any other oil-bearing concoction—remelt and stir it thoroughly before using if it shows the slightest tendency to "sweat." Other formulas which have been recommended include beef tallow with sufficient vaseline to soften. Be certain that your tallow contains no salt. Also do not store this in loaded cartridges, as animal fats will rot. . . . Vaseline with sufficient paraffin to harden was recommended about 1900 in an Ideal Handbook. Another mixture for immediate consumption: Japan wax with sperm oil to soften it. This was recommended and used more than forty years ago. It has been some years since the author tried this mixture, but it worked excellently. The sperm oil holds its place in the wax much better than mineral oils.

Seasonal Lubricants. A very important point is to see that your lubricant is "seasonal." You change from summer to winter oils in your car—do the same with your bullet lubricant. A mixture which is right for summer use may be too hard for winter handling, failing to lubricate the barrel properly, and giving problems of chipping, peeling, and crumbling in storage. There is nothing more discouraging than to take down a box of beautifully sized and lubricated bullets for loading, only to find that the lubricant has chipped and dropped from some of the grease grooves, thus necessitating relubrication. This happens frequently. Crumbling lubrication may mean that, no matter how gently you handle the bullet, some will flake and drop out as the bullet is being seated, so that many grooves will be dry. Also this excess material is packed into the seating die of the loading tool, changing the adjustment. A certain handloader, after assembling some 150 loads for his .38 Special, found that grease had packed in his seating tool so badly that the last fifty bullets were seated almost 3/32 inch deeper than the original loadings.

If you strike this problem of crumbling lubricant, the answer is not to relubricate the bullets "as is" but to remove all grease first. Gasoline and a rag will do the job if you only have a few, but it is slow and tiresome. The best way is to place the entire group in a pan of water and boil for several minutes on the stove. This melts the grease, which floats to the top. If the quantity of lubricant collecting on the surface is worth while, it may be saved by chilling, skimming, and air drying before again melting it. The bullets are salvaged from the water, dried, and again lubricated.

One of the best wax bases for bullet lubricant is ozocerite, a mineral wax from Siberia. Although the formula is not in my notes, it is believed that this is the basis of the Ideal lubricant. Ozocerite is an inexpensive material widely used by the

electrotyping industry. Printing plates or forms are forced into hot or semi-fluid ozocerite to give a perfect impression. These wax plates are then cooled, and placed in solutions where they are electroplated with a heavy copper shell which fills the impression perfectly. Into this shell is poured a special "type metal," and the final form is smoothed up and mounted for printing. The wax, of course, can be remelted and used over and over. If you have an electrotype shop in your city or town, you can readily purchase, through it, what wax you may need for lubricant. This wax is a stiff black, green-gray or yellow-gray substance, depending on the source of the supply. Usually, however, the material found in the electrotype shops is black. It can be softened for use by adding beeswax, mobilubricant, vaseline, cup grease, and similar oils and greases.

The lubrication field offers an excellent opportunity for experiment. Unknown mixtures should be prepared in small quantities. Assorted blends can be made, and the remelting and adding of ingredients to thicken or thin down the mixture is of course possible. I visited a handloader last summer and inquired about his lubricant. He brought out the finest bodied material I have seen in many a moon. When asked about the formula, my host smiled oddly.

"Well," he commented, "I'd tried about every formula I had ever heard of, and made up all sizes of batches. Four years ago I wanted to lubricate some bullets and didn't have any grease I liked, so I dumped all my odds and ends together and made up what must have been some five or six pounds. It is the best lubricant I have ever tried. No leading in guns, even with loads that previously gave trouble; finer accuracy than before, and ease of handling. I've got two pounds left, and wouldn't know how to duplicate it."

New Use for Dictaphone Records. There is still another source of lubricant for the experimenter. The author has been playing with broken dictaphone and Ediphone records. This also includes the wax shavings available in every office using dictating machines. It all began when I tried to think of something more practical than dumping worn-out and broken records and shavings into the furnace. Accordingly, I melted some of this down, found that it appeared to have reasonable lubricating qualities, and determined to put it to work.

Dictaphone cylinders are really not wax at all, but a metallic soap—a rather complex sodium aluminum stearate. The highest grade of stearic acid, such as is used in the best of hospital soaps and shaving creams, is used. Pure aluminum filings are then dissolved in sodium hydroxide and mixed with the stearic acid. Various neutral tempering agents are added to form the wax-like material chemically known as sodium aluminum stearate. There is nothing in this mixture that would be in any way harmful to rifle barrels; in fact, it seems

Removing lubricated bullet from a grease cake with a homemade cake cutter designed by A. J. Weinig of Golden, Colorado. Cutter is made from a .38 Special shell soldered to a .30/06 shell, the latter serving as the handle. Through the flash holes of both shells runs a wire to which is soldered a lip seen projecting over the top of the bullet. The side of the .38 Special case is cut out in part, and pressing on this plunger ejects the lubricated bullet from the cutter

to be more or less beneficial. The mixture is decidedly alkaline in reaction and would therefore tend to neutralize any acid fouling left by powder or non-corrosive primers. The wax as obtained by melting down the cylinders and shavings, however, is much too hard for use as a lubricant and must be tempered with beeswax, petrolatum or tallow. An enthusiastic experimenter can readily figure out how to achieve this result. The wax itself can be had for the asking by applying to any large organization using dictating machines. To them this material is waste, and they are only too glad to have someone take it away. Try softening

some of this with a little Castordag or Oildag and a small quantity of tallow.

My good friend, J. Bushnell Smith of Middlebury, Vt., has been cooperating with me on this dictaphone cylinder lubricant. He mixes the material with solidified oil as used in the best transmission grease. This is a clear and sticky material, and in its application he mixes equal parts for winter work; finding it to be a bit tacky for warm weather, he has cut down the solidified oil slightly,

Ejecting bullet from cake cutter

giving a final mixture of 60% "wax" and 40% oil. Two ounces of powdered graphite are added for each pound of mixture, and it has been found that this material performs excellently in an Ideal sizer and lubricator after being kept at normal room temperature for an hour or so before using—to soften it properly.

Smith makes this material up in the usual heat-blending process, permits it to cool, and then extrudes it through the same presses with which he makes his graphite wad strip, except that he substitutes a nozzle to make a ⅜-inch round rod similar to but somewhat larger than that of some toothpaste tubes. These rods can readily be stored in boxes after being cut to a suitable length, and in use it is a simple matter to soften the material to room temperature and then coil it for insertion in any pressure lubricator. This mixture is extremely economical; and the two pounds of lubricant can go a long way, and can be prepared for but a few cents.

Using this mixture in normal and heavy-velocity revolver and pistol loads, Smith reported last winter that on his target range he had recovered from a snow-bank back-stop more than ten pounds of pistol bullets so lubricated, and that there was plenty of lubricant left in each groove on the bullet. After several thousand shots in various handguns, using this material, he reported that there was no trace of leading, indicating that the mixture performed in accordance with its intent. Various other materials could be used to soften this dictaphone-cylinder waste, and since the basic "wax" costs nothing, here is a plentiful supply of lubricant which could be made by any handloader for the cost of a few cents per pound.

Two Methods of Lubrication. Having chosen the lubricant, one then comes face to face with the problem of lubricating the cast bullets. There are two methods in use—hand and machine lubrication. Hand lubrication is satisfactory, but disagreeable, messy, and slow. Bullets can be hand-lubricated by rubbing a lump of the wax over the grooves when the bullet is held in the hands. If the bullet is rotated slightly and sufficient pressure is brought to bear with the lump of lubricant, all grooves will fill up. A Kake-Kutter, described later, can be used to remove the surplus grease.

Another method is to use a small flat-bottomed dish or tin, standing bullets on their bases in the bottom, and not less than a quarter inch apart. Melted lubricant can then be poured over them to the necessary height to cover all grooves, and permitted to harden. Bullets are removed with a Kake-Kutter. This stunt works well with flat-base bullets, but is a total failure when gas checks are used, since these give a slightly rounded base to the bullets and prevent their standing up.

A third method consists of dipping the bullets, base first, in melted lubricant. It sounds easy, but it is no simple matter to hold bullets when your fingers get greasy. It would be better to build some form of bullet holder, which really is an easy problem. Use stiff copper or soft iron wire, and, with pliers, bend a circular loop to fit the nose of the bullet loosely. The surplus of wire is then carried down the side of the bullet and bent up under the base. The bullet is slipped into the holder, nose first, and the projection or prong extending from the loop to the base of the bullet is slid beneath the base. This wire loop should be strong enough to hold the bullet in position without too much tension. Held in this manner, the bullet is then lowered into the melted lubricant, taking care to dip it only to cover the top grease groove. It is then withdrawn, the wax permitted to harden slightly, and the bullet removed from the holder

and stood base up on some flat surface. Surplus wax is removed by a Kake-Kutter while still soft.

Sizing the Bullets. Kake-Kutters were originally designed by the old Ideal firm and are still manufactured by their successors and by Bond, Belding & Mull, and other reloading firms. It is not necessary, however, to buy these, as the average handloader can make his own with reasonable success and with only a few moments of labor. First choose an ordinary shell of caliber slightly larger than the diameter of the bullet *as cast*. An ordinary cartridge case can be expanded to proper dimensions with a suitable plug. Then cut the entire head from the case with a hacksaw, smoothing the edges with a file. The case should then be washed and dried to remove tiny chips or filings of brass, whereupon it is ready to use.

Your Kake-Kutter is slipped over the nose of the bullet and pressed home. It is often wise to heat the cutter slightly that it may better cut through the wax, but this is not always necessary. The cutter, containing the bullet, is lifted from the group and pressed over the next one. Gradually they will emerge from the top, the new bullet pushing out the ones previously cut from the mass of grease. They are then laid aside for the final operation of sizing.

All bullets to be resized must first be lubricated. This is important. The lubricant makes the sizing job easier, cuts down wear on the die, and the latter, in turn, scrapes off all surplus grease, packing the grooves neatly with the wax. Certain bullets cannot be sized, as they are designed to be used lubricated but *as cast*. These bullets are of the customary multiple diameter types, such as the Pope and Squ bb-Miller forms. All ordinary types must be run through a resizing die to insure elimination of fins and uniform diameter.

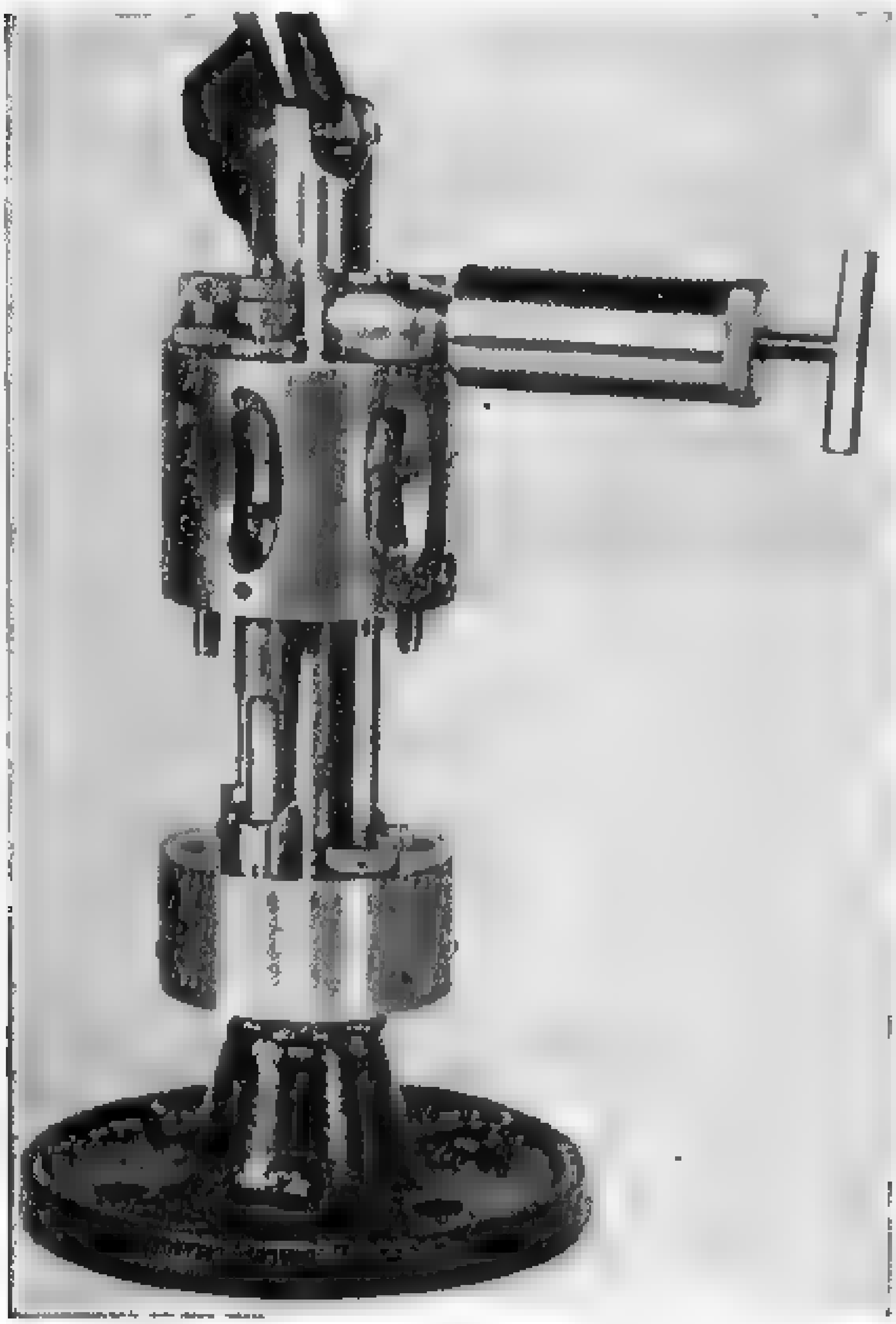
On a visit with my good friend Harvey A. Donaldson of Fultonville, N. Y., in the summer of 1935, I got hold of a very practical suggestion on the problem of lubricating without Kake-Kutters. Donaldson showed me his method—one which he insists is not original but which he learned about 1895 from other riflemen who used it during that period. It works successfully. He places a group of bullets in a flat tin, spacing them at least one-half inch apart. The pan is then put on to heat slightly, and melted lubricant is poured in slowly to fill the warm pan to the proper level. It is a waste of effort—and a messy job—to lubricate bullets on the front or nose section. The top grease groove indicates the proper depth to pour the lubricant.

Once the grease has been added, the pan is removed from the heat and chilled slightly by setting it in a dish of cold water. As soon as the grease solidifies, the entire cake is lifted from the pan, bullets and all, and the bullets pushed *through* the semi-plastic cake with the thumb. Properly done—and it takes very little experience—the grooves are evenly filled with grease, whereas a cake cutter frequently tears some of the grease from the grooves. When the bullets are entirely removed from the case, it looks like a well-perforated cheese. It is then returned to the pan, and each hole again filled with an unlubricated bullet. Heat is applied, and the lubricant soon runs into the grooves, eliminating the pouring, and greatly simplifying the process of spacing the bullets. The routine can often be repeated three or four times before it is necessary to add more lubricant. And Donaldson always keeps these cakes of perforated lubricant on hand in several calibers for speedy lubrication of new batches. He uses cigar boxes for the storage of these solidified cakes.

The machine sizers and lubricators are, of course, by far the best bet, and the handloader who intends to cast large quantities of bullets should invest in one. Among the popular forms one finds the famous Ideal, which has been in use for more than forty years. This, like all others, uses interchangeable dies, so that the handloader may change his machine to handle as many calibers and sizes as his fancy may dictate. The Ideal machine first resizes by forcing the bullet into the die by means of a plunger. This die is fitted with several lubrication holes, and while the bullet remains in the die, the wrench on top of the grease chamber is given a partial turn, forcing the lubricant by means of a powerful screw-type plunger through the holes into the die and into all lubrication grooves. An upward movement of the bullet-operating lever causes another plunger to rise and force the bullet out of the die, where it is picked free with the fingers and stacked in a convenient box or receptacle. The Bond press is almost identical with the Ideal, having a few minor changes in various parts, but operating in much the same manner. Incidentally, where sizing is done, all bullets should be inserted in the dies, regardless of type of die used, *base first*. This prevents any fins from being formed on this important part of the projectile. The Bond sizer and lubricator is similar in design and operation to the Ideal, having but few additional refinements.

The best sizing press on the market—and the newest and most expensive—is the Star, manufactured by the Star Machine Works of San Diego, California. The author has been using one of

these for more than three years and has found it the fastest and easiest to use of the entire tribe. With this outfit the work and mess of sizing and lubrication is entirely eliminated. One operation is all that is necessary. The bullet is seated over the mouth of the die, base first, and the operating lever pressed all the way down with a steady motion which can be developed into quite speedy operation. A reservoir at the bottom of the press contains a small amount of grease, forced into it from the operating chamber by a spring-backed plunger. A cam arrangement is on the handle, and while the first half of the downward movement of the lever forces the bullet into the sizing chamber of the die, the remaining part of the handle travel operates the auxiliary lever on the side of the machine, forcing grease into all grooves with no surplus to smear over the sides and bases of the bullet. The lever is raised and a new bullet started immediately, with the previous one remaining in the die, all sized and lubricated. A single downward throw of the operating handle forces the old bullet out of the bottom of the die, and the new one takes its place.



Lubricating attachment for Jordan Loading Tool (see Chapter XXII)

This press is mounted on the edge of the loading bench with a slight overhang. One merely holds one's hand beneath the overhang to catch the bullet, eliminating the somewhat slower process of picking out a bullet with greasy fingers. Actually, on test, the author has been able to size and lubricate bullets four times as fast as in the older types, since it is not necessary to "pick" out bullets or to twist the lubricating chamber wrench at each sizing. A single tightening of the wrench will last for about 100 bullet lubrications.

The two-diameter bullets such as the Pope, Squibb-Miller, and similar developments, although not intended to be resized, can be so handled in an Ideal or Bond press if a special die, obtainable from the makers, is used. This die is a great help to speedy lubrication and insures proper packing of the grease grooves.

In addition, one can frequently pick up some of the old Stevens-Pope lubricating pumps. If you find any of these in working condition, snap them up; if you have no use for them, some fellow handloader will be glad to get one. These brass pumps were not resizing machines—you merely inserted the bullet into the chamber point first, twisted the pump key, and forced grease into the grooves.

Ordinary hand resizing dies can also be used with reasonable success, but the type found in the old Bond Model B can be used with better success if detached from the loading tool handles. One enterprising handloader wrote me some years ago stating that he made his own bench resizing press by using these dies and building a light framework with a hand lever to operate a plunger in a straight line. A downward push on his lever forced the bullet into and through the die, which was merely dropped into a proper size of hole bored into a U-shaped piece of quarter-inch iron, mounted upside down. There was sufficient room beneath this arch of iron to permit the insertion of the left hand beneath the projecting resizing die, so that the bullet could be started with the fingers and then caught as it made its exit through the bottom, eliminating the necessity of dropping it to the bench and thus mutilating the base. This same stunt can be worked out using Belding & Mull and many other types of hand dies, thus turning a hand die into a speedy "bench press."

Still another chap who has assembled an entire set of strictly home-made handloading tools, tells of acquiring an old "bottling machine" such as is designed to force bottling caps on the wrappers of

beer, root beer and other home-made stomach lubricants. This device was of the "rack and pinion" type, in which the necessary leverage is multiplied by means of gearing. He soon altered it into a highly satisfactory resizing press, both for his bullets and for shell resizing. In the latter process he used a quick-detachable head which straight-line-forced the shell into a hand die; then turned the die over and, with another plunger dropped into the shell, forced it out with a separate operation. It worked fairly rapidly. His rimless .45 ACP shells were forced right through the die, base first.

Only recently this experimenter wrote me that he had discarded this home-made affair since running across a foot-power brake-lining machine that had been discarded by a garage in favor of a modern type. He worked this over into a loading press, rebuilding the various parts to permit of interchanging dies for various occasions, and now has a bench-type tool capable of excellent work. This home mechanics sport, when stirred into handloading, makes the game intensely interesting. The perfect loading tool has not as yet been designed, and the average handloading fan soon finds ways and means of slightly altering existing tools to meet with his own ideas.

There is more or less argument about the advisability of wiping grease from the base of a bullet. Personally the author chooses to clean every bullet before loading. Wiping a bullet base is a rather simple process if one uses a cloth stretched over a board about six inches wide. Put a certain amount of padding beneath the cloth. Then, as the bullets are ready for final packing, grasp each by the nose and, with a gentle movement, draw it over the cloth for a distance of about six inches. This will usually remove all traces of grease. One handloader known to the author always wears a pair of old cotton trousers and wipes his bullets gently on his trousers legs. When the legs become soiled, he turns the trousers into the laundry, and invariably they come back grease and dirt free.

Colloidal Graphite. Another form of bullet lubrication the author has been experimenting with is colloidal graphite. This material is manufactured by the Acheson Colloids Corporation of Port Huron, Michigan. Colloidal graphite is the finest known form of graphite, and is, of course, artificially produced. The Acheson Colloids Corporation manufactures this material in the form of "dags" or solutions. Its line includes Aquadag, Oildag, Castordag and Glydag. The first-named is graphite suspended in distilled water—about 22% graphite. Oildag is colloidal graphite in a pure mineral oil. Castordag uses castor oil as its base, and Glydag employs glycerine. All of the latter are 10% colloidal graphite by weight.

Through the cooperation of the Acheson laboratories, the field of bullet lubrication has been scratched and shows excellent possibilities. Colloidal graphite is so finely divided that its grain structure is almost molecular, yet this does not alter its normal characteristics. Oildag is sold commercially as "Gunslick" for use in smoothing up actions, trigger pulls, and bolt runways. Experiments have been conducted by painting bullets with a light coating of the various dags and using no other lubricant. Performance is excellent. Particularly interesting is Aquadag. The formula I have tried with success seems to be from equal parts of Aquadag and water to 1 part Aquadag to 1½ parts of water. Use distilled water if possible, or clean rainwater. Paint the bullets over their entire bearing surface with a small camel-hair brush. It is quite speedy, once the knack of holding the resized bullet between thumb and forefinger is acquired. Then set the bullets on their bases to dry before loading.

This process gives a graphite-coated bullet, the colloidal graphite drying into a hard shell which penetrates the pores of the lead bullet. It wears well, and such a bullet needs no grease. Experiments with the .357 MAGNUM revolver, the worst offender from a leading standpoint of any of the various handguns the author has used, shows an entire elimination of leading. There is room for the handloader to play around with any gun which leads badly.

The cost of this material? Aquadag is the most expensive of the dags, costing 60 cents per 1/10 pint or $2.50 for a half-pint jar. The 1/10 pint (1.6 oz.) makes 4 fluid ounces of lubricating solution—good for thousands of bullets if properly applied. I made up that amount and dealt it out to four friends in one-ounce bottles. They are still using it, one chap having lubricated almost 1500 .38 Special bullets with his ounce—and he still has a third of it left. A safe figure is one cent per hundred bullets. The lubricated bullets are clean and dry and do not pick up lint and dust as do greased types. Furthermore, in quantity loading, the surplus lubricant which smears the point of the usual completed cartridge, to say nothing of packing in the seating die, is eliminated. The experiment is inexpensive to make and decidedly interesting.

Handling Bullets. Bullets, after casting, should be packed in boxes carefully. One mistake made by beginners—and rarely found in the loading rooms of experienced shooters—is the dumping of carefully cast and resized bullets loosely into cigar

boxes. DON'T DO IT! Secure or make small boxes about the height of the bullet and capable of holding from 50 to 100 bullets. The time used in wiping grease from the base of the bullets can also serve as an inspection period, and perfect bullets are then stacked base-down in these boxes, the covers being labeled with the complete record of the bullet style, alloy and weight, together with date of casting and lubrication.

In addition to the label on the top of the box, each package of bullets should be properly labeled on the exposed end, so that when stacked on shelves, it will not be necessary to tear down a stack to determine the contents. It is also a good idea to note on the cover of the box the type of lubricant, although if the handloader sticks to a single formula this is by no means necessary.

The experimenter with a full collection of tools will do well to use one of the sizing presses with standard prepared lubricant. This grease is superior to home-prepared types in many ways. It is of proper consistency for press use; and it is available in handy sticks so that it can readily be handled with a minimum of effort, and conveniently stored so that the recharging of the lubricating press is a matter of a scant few minutes.

Standard prepared bullet lubricant is supplied by the Ideal Manufacturing Co. (Lyman Gun Sight Corporation), Middlefield, Connecticut; Belding & Mull, Inc., Philipsburg, Pennsylvania; the Modern-Bond Corporation, Wilmington, Delaware; James E. Moon, 782 Amsterdam Avenue, New York City; Fielding B. Hall, 1322 Montana Street, Los Angeles, California; and Industrial Products Company, P. O. Box 14, Wakefield, Massachusetts. Incidentally, this latter firm supplies the Sharpe Colloidal Formula #2 in sticks for lubricating machines as previously described in this chapter. F. R. Krause of 801 East Coal Avenue, Albuquerque, New Mexico, also carries a stock of this colloidal graphite lubricant together with other standard makes of lubricants for those living in that territory.

Size your bullets as soon after casting as is convenient. Store them carefully, and keep a plentiful supply on hand. Then, when you decide to build a certain load on short notice, you have full equipment available.

One final suggestion: It often becomes necessary for the handloader to remove surplus grease from his loaded cartridges. Many times this grease is deposited over the nose of the bullet in a most disconcerting manner. While it does no harm to shoot cartridges so coated, they by no means represent a finished job, and many handloaders hesitate to appear in company with soiled loadings of this sort. The grease may be quickly removed if a small rag is dampened in gasoline and used to wipe the cartridges, a twisting motion being used. A far better way, however, is to use a small electric motor of about ¼ h.p. and a cloth buffing wheel. With such an outfit, the work becomes easy, and the cleaning of 100 cartridges is merely a matter of a couple of minutes. When the buffing wheel becomes too badly fouled with grease, it may be removed and washed in gasoline, dried, and returned. This same motor can be used for a multitude of purposes, the buffing of shells among them. The cloth wheels should be properly stored to keep them free from dust, and different wheels used for the various jobs. Heavy manila mailing envelopes make excellent covers for the storage of the wheels when not in use, and they may be attached in a moment. This electric motor—used—may be picked up for three or four dollars, or a new ball-bearing type can be purchased from the mail-order houses for less than ten dollars—a practical investment.

X

LEAD, GAS-CHECK, HOLLOW-BASE, HOLLOW-POINT, AND PATCHED BULLETS

PLAIN "lead" bullets consist of two distinctly different types—factory and home-made. The latter are further subdivided into plain-base and gas-check. A still further subdivision of the "plain"-base bullets consists of flat-base and hollow-base. Hollow-base bullets have a wide variety of forms—cupped, dished, truncated cones, and straight conical cavities. Flat-base bullets are either flat with sharp edges where they bite into lands and grooves of the barrel or have rounded or beveled edges as exemplified in the Belding & Mull and similar bullets.

The various forms of bullet bases have their regular following, much the same as many shooters prefer lever, bolt, pump or single-shot rifles. To state that one is better than the other will immediately start a serious argument, but there are many important defects in a few of the types.

Swaged Lead Bullets. Factory bullets differ from home-made types in that they usually have a different formula—lead and antimony—whereas most home-cast bullets are prepared of a mixture of lead and tin. Further, factory bullets are not cast, but *swaged*, and while the average handloader and laboratory executive is of the opinion that if two bullets of a given design and weight, one swaged and the other cast, will produce identical results in identical loadings, this is *not* the case. Many of the old theories of bullet performance are being shattered daily.

In the manufacture of factory bullets, some are turned out in the plain lead alloys, others are either plated with copper or gilding metal, according to the ideas of the manufacturers. In my experimental loadings, I have researched extensively with factory-swaged bullets made to my order, some of these being copper-plated, also to order, for direct comparison. While in every case the factories claim that copper-plated bullets (mostly for use in handguns) are superior to the unplated variety, actual experimental work has failed to prove this to be so. They are inclined to foul barrels more readily than the unplated variety, and no fouled barrel, particularly one with flaky or patchy fouling, will compare favorably with a barrel fouled only with normal products of powder combustion.

A factory-swaged bullet differs chiefly in texture from the so-called "cast" bullet in that its metal is formed cold, while cast bullets are built from molten metal poured into a mould. Factory bullets are made of pigs of the proper alloy which have been placed in heavy presses and compressed. The soft mixture is then forced through a die having a hole or series of holes, much the same as in the process used for the formation of smokeless powders or wire. If the bullet is to be used in a .38 Special and will have a finished diameter of .359, the alloy is squeezed through a die having an exit hole approximately .375 inch in diameter. This metal comes out in the form of lead wire or "rods" and is coiled up on large drums for future use. When it is desired to manufacture a batch of bullets, this wire is fed into special machines which chop off short sections similar to large unperforated powder grains, and in the case of a 158-grain bullet, the short sections, or "slugs" as they are then called, will weigh 165 to 170 grains.

These slugs are handled carelessly—they feed into a bin, usually in the form of a large hardwood box mounted on a small truck to facilitate easy handling. The slugs go to another machine for the final swaging; on occasion they are merely transferred to a hopper on another part of the same machine for this work. The slugs in small calibers feed direct to the finishing die. On some large bullets they are first "roughed" to approximately the correct shape to prevent seams or "folds" in the finished bullet. These "roughed" bullets are freed of surplus metal and brought to the correct weight by driving them into a die having a perforation, usually at the nose of the bullet, the surplus alloy extruding from the die vent as the slug is pressed home with the die plunger. This surplus or "scrap," in the form of a teat on the end of the bullet, is trimmed off to bring the roughed bullet to correct weight. It then goes into a finishing die to bring it to perfect contour or shape, but still lacks the cannelures or "grease grooves." These are added by means of an automatic machine which passes the bullet through a set of rotating notched-edge wheels or "knurls." The finished bullet is then ready for lubrication and loading. Lubrication during the swaging and handling steps of the construction process, however, is accom-

plished by lightly coating the bullets with graphite. This starts by tumbling the raw slugs in powdered graphite and during various steps this tumbling is often repeated. The process is not so much to lubricate the bullets as it is to lubricate the various swaging dies, thus reducing wear on expensive tool equipment. This accounts to no small extent for the dark color one notes on factory bullets even from a fresh supply.

This swaging process of the cold soft metal highly compresses the lead alloy, eliminating not only all crystalline structure in the metal but also all tendency toward "air pockets" or "blow-holes" such as are occasionally found in improperly cast bullets. The elimination of crystalline structure means a uniformity obtainable in no other way. Cast bullets will vary in crystalline structure of the metal, depending on the temperature of the alloy; the temperature of the mould will also directly affect the structure on the surface. Uniform bullets, therefore, when made at home, depend much on the skill of the handloader and the care he uses in casting.

The compression of bullet metal while cold has a tendency to soften the bullet, while melting and cooling hardens it. The result is that two bullets of identical shape and weight, made of the same alloy, will show slightly different ballistic results when tested with laboratory precision. Definite tests by the writer a few years ago showed that with a particular load in the .38 Special using cast and swaged bullets, the cast bullets ran approximately 10 f.s. lower velocity with over 1000 pounds higher pressure. Firings were, of course, under identical conditions, and were checked with a string of 25 shots of each type of bullet.

Gas-Check Bullets. Just how much velocity will a cast bullet stand? This question has cropped up consistently during the past quarter century, and the reply has been stereotyped for so long that many of our best handloaders and even ballistic engineers believe it to be true. They answer: "No plain alloy bullet with an unprotected base can be driven at a velocity greater than 1800 feet per second without fusion of the base and stripping in the barrel. No gas-check cast bullet will stand more than 2000 f.s. without stripping. . . ." Some even go so far as to claim 1500 f.s. for a plain base and 1800 for a gas check. This statement is not founded on fact. It is a relic of the past.

Years ago the writer was using a pet load of his with the 169-grain Squibb gas check and 27.2 grains of Hercules Sharpshooter. Cases were FA make and primer was the old Winchester #35NF—the same mixture as the FA #70. He knew all about the law which read that gas checks must not be driven over 2000 f.s. because they couldn't take it. But he didn't know what the load was giving. It happened to be a load worked up to consume a quantity of Sharpshooter we had on hand, and we merely came to the point where in that particular gun the best accuracy was obtained. At rest shooting, we had obtained several 1¼-inch groups at 100 yards, and on occasion had reduced group size to one inch. These groups, incidentally, were ten-shot ones, with measurements center to center instead of inside edge to inside edge. After a couple of hundred shots without signs of stripping, leading, fusion, poor accuracy, or anything of that sort, we decided to have the load chronographed for performance records. Of course the poor, dumb handloader assembling these loads thought he was "within the law." . . . The laboratory report showed a velocity of 2215 f.s. with a pressure of 33,500 pounds.

At the Hercules Experiment Station many tests have been run with both plain base and gas checks at velocities greater than "the law" with the result that we handloaders have gotta get us a new law. The old one ain't no good no more. Many special high-velocity gas-check loads together with slightly lower velocity plain-base data are included in the loading tables of this book. In the .25 Remington the 111-grain gas check can be driven at 2520 f.s., pressure 42,000 pounds with 24.2 grains of HiVel #3. In the .25/35 Winchester the same bullet gives 2280 f.s. with 32,000 pounds pressure. In the .250/3000 Savage 28.0 grains of the same powder back of the 80-grain gas check gives a velocity of *3000 f.s.* with 42,000 pounds pressure.

In the .30/30 Winchester 23.0 grains HiVel #3 back or the 150-grain *plain-base* bullet gives 1950 f.s. In the .30/06 we find that 39.0 grains with the 169-grain gas check gives 2600 f.s. with a pressure of 44,300 pounds. This is an excellent load in both of my Springfields. The 207-grain gas check with 38.4 grains of this powder develops 2350 f.s. The Squibb gas check in 169-grain weight can be driven up to 2520 f.s. in a 30-inch Krag barrel and 2300 in the .303 Savage. In the .33 Winchester a 195-grain gas check can be pushed up to 2425 f.s. with good accuracy and safe pressures. And so on and on.

In a statement made for our readers on this subject, Mr. L. C. Weldin, Ballistic Engineer of the Hercules Powder Company, writes under date of April 29, 1935: "In the .30/06 cartridge we have made a number of tests of the 169-grain lead gas-check bullets, obtaining muzzle velocities around 2600 feet per second. We never noticed any signs of stripping or undue leading of the barrel at these

velocities. Recently we received some ammunition from a handloader for tests which included .30/06 loads of the 140-grain gas-check bullet and 45 grains of Hercules HiVel #2. This load gave a muzzle velocity of 2775 feet per second. Another load included in this lot was the 76-grain plain lead bullet loaded in the .30/06 cartridge to a muzzle velocity of 3040 feet per second. No sign of stripping was noticed in either of these bullets. The loader reported three-inch groups at 100 yards with this high-velocity lead bullet load with *no* barrel leading. . . . Our experience has been, with gas-check bullets, that the velocity at which they can be driven depends on the bullet, the individual gun, and the powder being used. . . . It is quite possible that some rifles will not handle some gas-check bullets above 1800 feet per second. . . ."

About the same time, Wallace H. Coxe, Ballistic Engineer of Du Pont's Burnside Laboratory, commented: ". . . We have found that they can be used satisfactorily up to 2000 foot-seconds where the gas check is properly fitted to the bullet. A great many reloaders have trouble using either too large or too small a gas check. In the first case the gas check is probably stripped from the projectile in the barrel, and in the second case the gas pressure leaks around the small gas check and probably fuses the bullet. . . ."

Originally a gas check or small copper cup was placed over the bases of lead bullets for use with smokeless powders to prevent the hot gas under pressure from melting or fusing the base. Mr. Coxe is correct in his analysis of troubles listed above—most gas checks fit the bases improperly and will not permit of high velocities. Performance depends on bullet, not on speed laws. The early gas checks were very loosely fitted to the base of the bullets, the idea being that they should fall off shortly after the bullet left the muzzle, and thus permit unhampered flight of a projectile with an unmutilated base. Most modern gas checks stick firmly to the bullets and are found on the bases of recovered projectiles. If they fit correctly, and bite into the grooves of the barrel to perform a perfect gas seal, no fusion of the bullet base will result, and high velocities may be achieved. Alloys should, however, be not softer than 1 part tin to 10 of lead, or preferably antimony in place of tin. I rather suspect, however, that my good friend Coxe has stayed "within the law" on his velocity recommendations chiefly because he is a law-abiding soul. I've used plenty of Du Pont powders with that Squibb bullet and velocities of up to 2400—and never had cause for complaint.

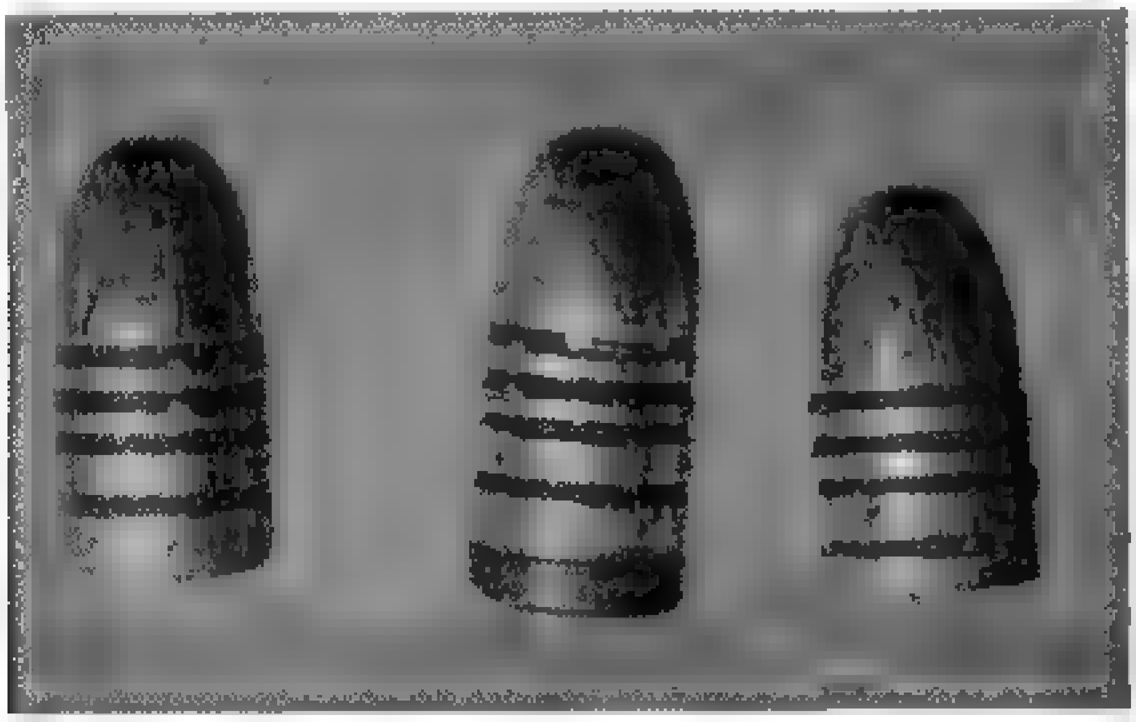
Gas checks, therefore, should fit the base of a bullet snugly if their true protection value is to be realized. The pressure of the powder gases acting on the gas check during the initial burning of the powder should wedge them tightly and completely seal the base against the cutting-torch effect of leaking hot gases. It is very important that the handloader bear constantly in mind that no gas-check bullet should be seated into a case neck so the gas check or base of the bullet extends into the powder cavity of the cartridge case. The little copper cup should at all times be held *within the neck*. Otherwise, it is quite likely to drop off the base of the bullet before firing and mingle with the powder charge. It may be completely blown out of the muzzle or may rush out with the last escaping gas and become wedged in the barrel in such a manner that the following shot will wreck the gun. This has happened numerous times with handloaders, but if a tight-fitting gas check is used with the base of the bullet seated *only* into the neck, this problem is practically eliminated.

H. Guy Loverin of Lancaster, Massachusetts, who for many years has conducted a successful business of casting bullets for handloaders, is extremely strong for the gas-check bullet. During the spring of 1935 he designed a new .30-caliber bullet weighing 160 grains which is as near perfectly engineered as any bullet on the market. After drawing up the plans, Loverin had Bond make the mould to his specifications and sent me some of the new bullets from his first batch of castings. This bullet, now bearing Bond number 311910, is entirely different in shape from the accepted standard. Instead of a straight "step cut" for the base, the Loverin bullet uses a beveled shoulder. On being fired the gas check is driven forward, biting into the bevel, and expanding slightly so that it completely fills the grooves. Next comes a lubricating groove, somewhat different from that designed by past custom. In shape this is nearly a perfect "V," the two angles helping to line up the bullet both in the case neck and as it jumps into the rifling. In front of this is a typical "square cut" lubricating groove, and continuing toward the nose of the bullet we find two more lubricating or crimping grooves with a square forward face and a sloping rear. The designer claims that these, together with the very narrow front band and smaller (land) diameter forward portion of the bullet, help to line the bullet with the axis of the bore and aids in securing perfect accuracy. The Loverin bullet shoots well and the gas checks stay on—I have shot them into sand banks and dug out the shattered remains,

only to find that copper cup very tightly wedged to the bullet base.

Bullet Diameter. How large should a bullet be for the best performance?

Here again we have another "law." And here again the author is firmly convinced that the law should never have been passed. Many years ago, when we first began to handload ammunition, the law was read to us in no uncertain terms by authorities of the day—law which was passed along to them by others. How large should a bullet be? Why, at least .003 greater than the diameter of the



The only practical and accurate cast bullets for use in the Hornet rifle are those designed by H. Guy Loverin and manufactured by Ideal. These are turned out in three bullet weights. Left, a bevel base; center, gas check; and right, flat base

grooves. It might even be .005 inch. In fact, the larger the bullet, the better the chance for completely filling the grooves of the barrel and consequent lack of gas cutting.

For years we obeyed that law. And then we began to think for ourselves. The old law was studied in a search for technical errors. We found them in plenty. *First:* If a barrel is rifled with a maximum groove diameter of .3080 and a land diameter of .3000, and a bullet having a diameter of .3080 were pushed through it, why wouldn't it completely fill the grooves? *Second:* If a bullet having a diameter of .3110 were pushed through that .3080 barrel, why wouldn't that reswaging tend to destroy the original balance of the bullet, particularly if it happened to start into the rifling a bit off-side? *Third:* If a .3080 barrel normally requires a .3085 metal-jacketed bullet, and this law says that cast bullets should run .3110, why is it that the metal jacket—of very many times harder metal—will swage to fit the grooves, while the soft cast bullet in the same size will not?

An experimenter soon puts his ideas into practice, and we soon reswaged .3110 bullets to diameters around .308 and tried them. Accuracy at the short test range of 50 yards was excellent, and recovered bullets showed that they had adapted themselves very nicely to the dimensions of the barrel. We then stepped the diameter to .306 and shot them in that .308 barrel. Accuracy was *still* all that could be desired, and again the recovered bullets clearly showed that they had upset to perfectly fill the grooves. There was something technically the matter with that law—probably passed in a hurry by some overanxious politician who wanted to get home for the holidays. Thus we answered our own question Number 1.

Came Number Two. We fired the legal .311 bullets in that same barrel. To be perfectly truthful, the die sized them to .3112. Recovered bullets showed a pronounced fin around the base of the bullet. We tried some of the Belding & Mull bevel-base bullets of the same size. The fin was practically missing, but the bevel was more or less mutilated. And then came a session with that excellent book, *The Bullet's Flight from Powder to Target,* written by Dr. Franklin W. Mann, America's pioneer gun bug and experimenter. This old book, written in 1909, is still an unequaled masterpiece, and it is to be regretted that Dr. Mann passed on before he had published his second book. He took with him to his grave the answers to many questions which today's riflemen are still seeking.

In 1902 and 1903 Dr. Mann definitely proved that fins on the bases of bullets could nearly destroy their accuracy possibilities. But that was a long time ago. We have forgotten the work of Dr. Mann. And we passed laws which the Supreme Court of Logic would set aside as unconstitutional. Bullet bases *must be perfect* if their greatest possibilities are to be developed. Why, therefore, should the handloader go through his cast bullets with infinite care, choosing only the perfect specimens, *and then slug them all out of their original identity by shooting them in a barrel three or four thousandths of an inch too small for them?* You chaps who passed the law may be able to answer it—the author can't.

Question Number Three. There once was a logical reason for cast bullets to be several thousandths oversize. The general theory back of this old idea is that a bullet must have a surplus of metal to swage into the groove corners and thus prevent gas cutting. A thousandth, perhaps, but that is enough. You would not ask a metal-jacketed bullet to swage down as much as that; why demand it of a lead-alloy bullet? It is not logical. Bullet-mould makers—and this applies to most of

them—are inclined to make their moulds oversize—too much so. Their engineers design a very excellent bullet, its bearing surface properly worked out for best results in a certain barrel. They cast it oversize for fair. Many .30 moulds even cast bullets .320 to .325 to be shot in a .308 barrel. No, the pretty handbooks they send you for a quarter or half a dollar do not tell you this, but it is true in many cases. You have to resize the bullets.

How do you resize? You drive the bullet through a die to make it of the proper diameter. In the case of a .30/06 with a bore diameter of .300 and a groove diameter of .308 you force that .320 bullet through a hole in a metal block and it comes out .311 inches. Then you load it into a shell and blow it through a rifled tube, the greatest diameter of which is .308, and the mean or average diameter of the rifling and grooves is .304. When the bullet leaves the muzzle it is squatted down to a maximum diameter of .308, a reduction of .012—twelve thousandths smaller than originally cast. What's the idea? Just THE LAW.

Accuracy tests have proved conclusively that it is not necessary to use bullets three thousandths oversize. The soft bands cast on the bullet and filled with lubricant are squatted out of their original identity by the various resizings. Sometimes they crush down evenly, sometimes the majority of the "sizing" occurs on one side of the bullet. The net result is a badly unbalanced bullet—and that means poor accuracy or worse. No, the Law is wrong again. Cast bullets need to be but slightly oversize. Too much so means that they are more or less certain to expand or upset too much, creating excessive *and irregular* barrel friction. This means excessive heat developed in the bullet, cutting down the velocity, the resistance to the rotational bite of the lands, and thus a tendency toward slippage.

The only logical excuse for this oversize theory was recently offered by one of the old-time handloaders who pointed out that the great "standardization" of Springfield Armory is a matter chiefly of recent years rather than of the beginning of their history. When the Krag rifle came into existence it brought with it a flood of reloading fans, particularly those who wanted a gallery loading considerably less erosive on the barrels than the standard full charges of poisonous WA. The author recently measured a great many Krag barrels that he owned and found that they ran from .305 to .311. Research through some printed literature published around 1905 by the National Projectile Works of California (now extinct) indicates that even in those days this great variation was known to shooters. At the same time it was determined quite early in the game that the average Krag barrel was *oversize* rather than undersize. Formal research by the author at Springfield Armory elicits the enlightening information that "they cannot account for the great variation in Krag barrels."

The loading fans, however, in discovering that Krags usually ran .3085 to .311, insisted on a slightly larger bullet than .308, and .311 became the accepted standard. It is quite possible that a few of those loaders who had tight barrels resized their bullets to a somewhat smaller initial size. It is thus possible that this may account to a certain extent for the general trend toward oversize bullets. Thus there might have been an excuse for it in 1905, but certainly not with the standardization of all calibers during the past twenty years!

Another possible answer to the oversize bullet problem is that the truly early bullets had very narrow and extremely deep lubricating grooves running from four to eight grooves per bullet. The driving bands, therefore, particularly when cast in a soft alloy such as 1 to 30 or 1 to 40, which was quite popular in those days, would readily swage down .003 to .004 without causing serious trouble in the form of bullet mutilation or extreme pressure. With the more modern cast rifle bullets, however, the tendency is toward one- and two-groove bullets, using very shallow and wide grooves and even wider driving bands. These bullets naturally create much greater resistance to the rifling and were designed for increased velocities. The narrow groove with consequent narrow bearing bands would strip if an effort were made to step up velocities. Bullets with wide bearing bands in particular should be carefully chosen as to size, and for normal rifles .001 to .0015 greater than groove diameter is superior to those which are greatly oversize.

It is interesting to recall, however, that despite the tendency of our handloaders toward these tremendously oversize bullets, the fad did not extend into our ammunition factories. Those boys held oversize bullets to an absolute minimum; in fact, their tendency was toward slightly undersize rather than oversize, assuming that any cast or swaged bullet would upset sufficiently to fill any normal rifling. Incidentally, in the early days of factory-made ammunition, including that loaded at Frankford Arsenal, bullets were actually cast rather than swaged. The casting, however, was accomplished more or less automatically by bulky machinery in which an operator was able to cast by means of a

tremendous "gang" or multiple cavity mould running from 10 to 50 bullets per throw. These cast bullets were then machine lubricated and sized along the same general lines as those of present-day handsizing machines, except that the machines were automatic and a single operator could take care of an entire battery of them.

Hollow-Base Bullets. Another popular fallacy is the matter of hollow-base bullets. Why are these used? There are plenty of old laws to explain it, but the fact remains that the hollow base is a relic of black-powder days and is as obsolete as the flintlock. It has no legitimate place in the handloader's realm of action. The hollow-base bullet, some authorities say, originated in the effort of "engineers" who felt that the weight of a bullet should be kept forward, with a long base or skirt to "steer" the projectile in flight. Even as late as 1935 the Western Cartridge Company developed its new Super-X .38 Special cartridge, a 150-grain bullet built with a conical metal-covered point, and a round-nose 150-grain with a thin Lubaloy plating. These bullets have a deep conical cavity about ⅜ inch from the base, thus giving a very long bearing on the barrel. The net result is that the Super-X gives a velocity of 1070 f.s. as against the Remington .38/44 at 1125—the latter with eight grains more of bullet weight. There are two very important reasons for this increase in velocity—powder and bullet design. Eliminate the former and analyse the latter.

The pressure of the gases is sufficient even to bulge the base of a metal-jacketed bullet. Tests with a .22 revolver at the Smith & Wesson plant a few years ago showed that if the barrel were removed from a .22/32 revolver, and .22 Long rifle regular speed bullets shot from this gun into cotton waste—shooting from the cylinder, only, through the open forward portion of the frame—the recovered bullets had expanded to about .45 caliber from the blast of the gas on the bases, *and these badly expanded bullets showed marks on them where they had opened up sufficiently to graze the threads of the frame.* The experiment is not new. Dr. Mann conducted it with various bullet alloys in barrels of assorted lengths, some of them so short that the bullet of his rifle cartridge projected from the very short muzzle before firing. Burnside laboratory has conducted this test with metal-jacketed .30/06 bullets, and even these have swelled out of shape, expanding at the base to better than .38 caliber.

If the gases will do this to a plain flat-base alloy or metal-jacketed bullet, what will they do to a hollow-base bullet in your rifle or revolver? The answer to this question is very important—to both the shooter and the life of the gun.

The object of the hollow-base bullet is a matter *not* of "keeping the weight forward" but of permitting expansion by powder gases in black-powder weapons. In the revolver, for instance, the .38 Long cartridge (centerfire) came before the .38 Special. At that time smokeless powders were entirely unknown and impractical in experimental samples. From 1894 to 1909 the Army used four different .38 revolvers, all chambered for the .38 Long Colt cartridge with its deep-cavity, lead-alloy bullet. The Models 1894, 1896 and 1901 were all rifled with a groove diameter of .363 inches, the bullet being .357. Therefore, in jumping from the cylinder to the throat of the barrel, the bullet had to upset considerably and then swage back down to some .006 greater than its original diameter. This reswaging of the upset bullet gave rise to many problems—shaving of lead, excessive pressures, poor accuracy, leading of the barrel, *and* a belling or swelling of the throat of the barrel where it projects through the frame. This greatly increased the "clearance" between barrel and cylinder, permitting excessive "side spit," and if the belling continued, the barrel and frame were inclined to split. Accordingly, the 1903 model was brought out, chambered for the same cartridge, although the .38 Special cartridge had been introduced by Smith & Wesson, followed a couple of years later with the .38 Colt Special. The major difference between the Model 1903 and the earlier types was in barrel dimensions—the Ordnance Department reduced the barrel to .357, the exact diameter of the bullet. The .38 Special cartridge was developed by Smith & Wesson primarily because of the inferior ballistics of this hollow-base black-powder cartridge, which, even in later smokeless loadings, was highly unsatisfactory. Recent factory loadings examined by the writer in Long Colt caliber still retain the hollow-base bullet.

In rifles, no hollow-base bullet can be made to shoot as satisfactorily as the plain flat-base or gas-check. It is not used, and hollow-base rifle bullets are becoming rare. In the handgun family, however, the hollow base is featured among practically all the mould makers' lists. There is no law against its use, and it is featured in the line for just one reason—an attempt to reduce bullet weight with solid-nose type of construction and still maintain a particular length and shape of bullet. Actually hollow-base bullets are inferior in accuracy to the solid type, even when cast of hard alloys. Handgun pressures are sufficient to upset them in

the throat of the rifling, and with heavy loads this increases the pressure very seriously.

A certain hollow-base bullet, much praised by its designer and many writers, was tested in heavy loadings in the .38 Special and .44 Special. A sample batch was sent to the Peters Cartridge Company for these tests, and Col. W. A. Tewes wrote the designer who submitted them, condemning the load in no uncertain terms. At the same time he sent me a carbon of his letter, and a few days later a similar copy was received from the chap who loaded and submitted them. This letter runs:

"We find that your first sample of .38 Special contains approximately 11 grs. of Du Pont #80 and a 158-grain cast bullet of your design, generated pressure averaging 42,000 lbs., the maximum being 43,700 and a minimum of 41,100. . . . The second sample of .38 Special loaded with 10 grs. #80 and your hollow-point bullet weighing 160 grains averaged 42,700 with a maximum of 43,700 and a minimum of 42,000. [Note: This was a flat-base bullet, and clearly indicates that #80 is not at all suited to heavy loads in revolvers. P. B. S.] . . . These pressures are much too high for .38 S. & W. Special Cartridges and the arms which this ammunition is chambered for. Our working pressures in the standard velocity average 15,000 pounds, while the maximum allowable must not exceed 16,000 pounds. Pressures on our High-Velocity .38 Special average 17,000 pounds with a maximum allowable of 20,000.

"Your third sample .44 S. & W. Special containing 15 grs. of Du Pont #80 and a solid-point bullet of 231.5 grs. [hollow base] averaged 29,000 pounds pressure with a maximum of 29,400 and a minimum of 28,800. Our working pressures for the .44 Special average 11,000 pounds with a maximum allowable pressure of 16,000 pounds. . . . We did not fire any of these cartridges for velocity, since the pressures are dangerously high and we did not wish to subject our guns to these abnormal loads. . . . We really believe that if you continue to shoot loads assembled like these samples you will eventually have a serious accident."

There is another kind of "hollow-base" bullet the handloader frequently encounters—the factory-swaged bullet. This differs more or less from the cast bullets in that it has a very shallow cavity. Some bullets of this kind are merely "dished," while others have a small hemispherical cavity of varying depth running from .075 to about .135. In these swaged bullets, the cavity is formed by a suitable nose on the punch or plunger which forces them into the finishing die. Why this needs to be a cavity type of punch, no one seems to know. Thus the cavities of the ordinary factory unjacketed bullet bases are a matter of manufacturing convenience rather than any attempt at ballistic improvement, probably to take care of variations in slug weights and still maintain regular bearing length.

As a matter of fact, when the Winchester people began their experimental work with the .357 S. & W. Magnum revolver cartridge, they were continuing certain work of that nature conducted by the writer with the help of Major D. B. Wesson. This cartridge and the gun to handle it were born in the depths of the Maine woods several years previous to its introduction. Major Wesson and the writer were experimenting on a "Field Expedition," trying to determine the effects of certain super-velocity handloads in revolvers, and in our earliest experiments we rejected the hollow base as giving a highly unsatisfactory relation between velocity and pressure. The Winchester experts, faced with these data, which were turned over to them for development work, insisted that it was necessary to make a semi-hollow base as a manufacturing step. They built test bullets along the lines of the Sharpe experimental (Hensley moulds #48 and #51), but with swaged hollow bases, and found it impossible to equal velocities obtained with hand-cast bullets. Accordingly they manufactured some flat-base types, much to their surprise.

The writer does not know how difficult it may be to produce these "flat-base" types in factory production, but it should be as simple as to form the cavity type. The fact is that after saying "it can't be done" more or less because of another obsolete "law," the Winchester plant went ahead and broke the law itself. Strictly speaking, however, the Winchester, .357 S. & W. Magnum bullet is not a true "flat base." It has been slightly "dished," but this dishing is uniform from rim to rim and the depth of the dishing is only about .0075 inch. Therefore they shattered all previous theories, developing a 158-grain bullet which is driven at 1510 f.s. in an 8¾-inch barrel to make the world's most powerful revolver. This bullet, in its present state, has been driven as high as 1620 f.s. by the writer. With an experimental powder of *known* ballistic qualities, and using advanced formulae for calculating the probable velocities and pressures, we found that the chronograph and pressure gun verified figures—indicating that no unknown quantity entered into the case such as was found with hollow-base types.

Hollow-base bullets are perfectly all right for

normal loads, but for the finest of target accuracy they cannot compare with a properly designed flat-base bullet. The careful handloader will, therefore, endeavor to eliminate hollow-base bullets from his precision loadings if he seeks superior accuracy.

Hollow-Point Bullets. Cast bullets are excellent game killers, and in this respect the shape of the point or nose helps to no small degree. The .357 S. & W. MAGNUM, for instance, as loaded by Winchester at present, contains a solid alloy bullet having a "Sharpe-type" bullet. It is possible that the manufacturers may later add a hollow point to this line, should the demand of the shooters force the issue. But this Sharpe-type and Keith-type form of bullet nose should not be misunderstood. Neither type was actually originated by the two designers for whom they are named. The idea is as old as the hobby of handloading, and has progressed in varying stages of development ever since centerfire cartridges appeared on the market, thus bringing in the first crop of true experimental handloaders.

In the July-August (1935) issue of *Army Ordnance,* in recounting the history of this, the newest and world's most powerful revolver cartridge, this author says in part: "The so-called 'Sharpe-type' bullet nose is by no means an original development with him. Its actual origin is lost in the maze of antiquity. For handguns it was first used in the Wilder bullet designed by B. F. Wilder back in 1904 and now known as Ideal #360271. This was followed in 1905 by Crabtree's Ideal #360345, still very similar. Since that time there have been dozens of them developed, visually quite similar. Bond has bullet moulds for them, and so have Belding & Mull; and Elmer Keith popularized this type for hunting purposes. In spite of all this, the shape of the bullet nose is even older. It was widely used on rifle bullets, the flat nose being developed for nose cut-offs in bullet moulds built for home casting, thus insuring perfect bases for target work. It appeared in factory bullets for such rifles as the .32/40, .38/55, .38/56—in fact, most of the old and now obsolete line of bullets from the .22 WCF, .25/20 and .32/20 up to .45 caliber were of the flat nose variety. . . ."

This nose, however, has been varied considerably by various designers, and today has been refined to a remarkable degree. It is ballistically well balanced, although not quite the equal of the round nose and pointed types, and the greater cross-sectional area of the flat nose, presenting a flat surface of the bullet to meet the surface of the target or game, thus punches out a large hole and delivers immensely superior shocking power for hunting. The step-cut or shoulder, where the forward or cylindrical portion of the bullet body joins the nose of the projectile, forms an excellent "wad-cutter," punching clean holes in paper and hide alike. This, in solid-nose bullets, means a greater diameter of entrance and exit hole, adding to the shock of impact, nature of wound, greater bleeding, and consequent greater ease in trailing wounded animals not hit vitally. This same nose shape with wad-cutting shoulder, when used in hollow-point bullets of the Keith and Sharpe type, insures better and more effective expansion, usually accompanied by a shattering of the bullet nose with the base portion remaining undamaged to give greater penetration.

Special Moulds. Bullet moulds can be made in any reasonable style and shape and to any handloader's specifications, provided he is willing to pay the price charged by various mould makers for this work. Before the ambitious handloader rushes blindly into the problem of special bullets, he should, however, learn the way bullet moulds are manufactured, that he may better understand the problems to be conquered.

Moulds are made of various materials—cast iron, malleable iron, bronze (brass), nickel-iron (an alloy of iron and nickel) and pure nickel. All of these materials are practical, and the major differences are more or less those of individual preference. A user of a nickel-iron mould criticized it severely to the writer a few years ago, stating that it was not satisfactory. Either it was poorly made, of improper metal, or incorrectly designed. Moulds of this material are satisfactory if they are made right. And the writer clearly states that all makers of moulds turn out amazingly poor specimens from time to time. You may get a lemon in any make of mould. If you do, and after extensive use you are unable to get good bullets from it, *send it back*. Most mould makers will make good under these circumstances.

Regardless of the type of material used in mould blocks, the principle of manufacture is the same—cutting is accomplished through the use of a "cherry" or "cherrie." This is nothing more than a cutting burr or reamer, with suitable relief for the elimination of the metal chips or "shavings." It is ground to the exact shape of the desired bullet, and this cherry is used to cut all bullet moulds of that type. As the cherry wears down or dulls and is resharpened, it reduces the size, thus controlling the size of the finished bullet "as cast." Therefore, after exceeding the unfortunately too-wide tolerances of mould makers, this cherry cannot be

used further for finishing the moulds of that type and is either discarded or used to "rough" other moulds, the final shaping being accomplished through the use of a new cherry which is again ground to the original specifications.

In the manufacture of the moulds, two systems are used—the blocks being first paired off, their faces milled to give a smooth, leak-tight fit, and then they are inserted into a jig, given a rough or preliminary boring, and slowly clamped over the spinning cherry. As the revolving cutter bites into the metal, the jig is further tightened, until the faces of the blocks are in contact with each other. The blocks are then fitted into other jigs to drill the necessary holes for handles to insure their lining up in use, and the mould is ready. Some makers use a "fixed" or non-rotating cherry, revolving instead the jig containing the paired blocks. This latter system is not so widely used, as it requires more complicated equipment.

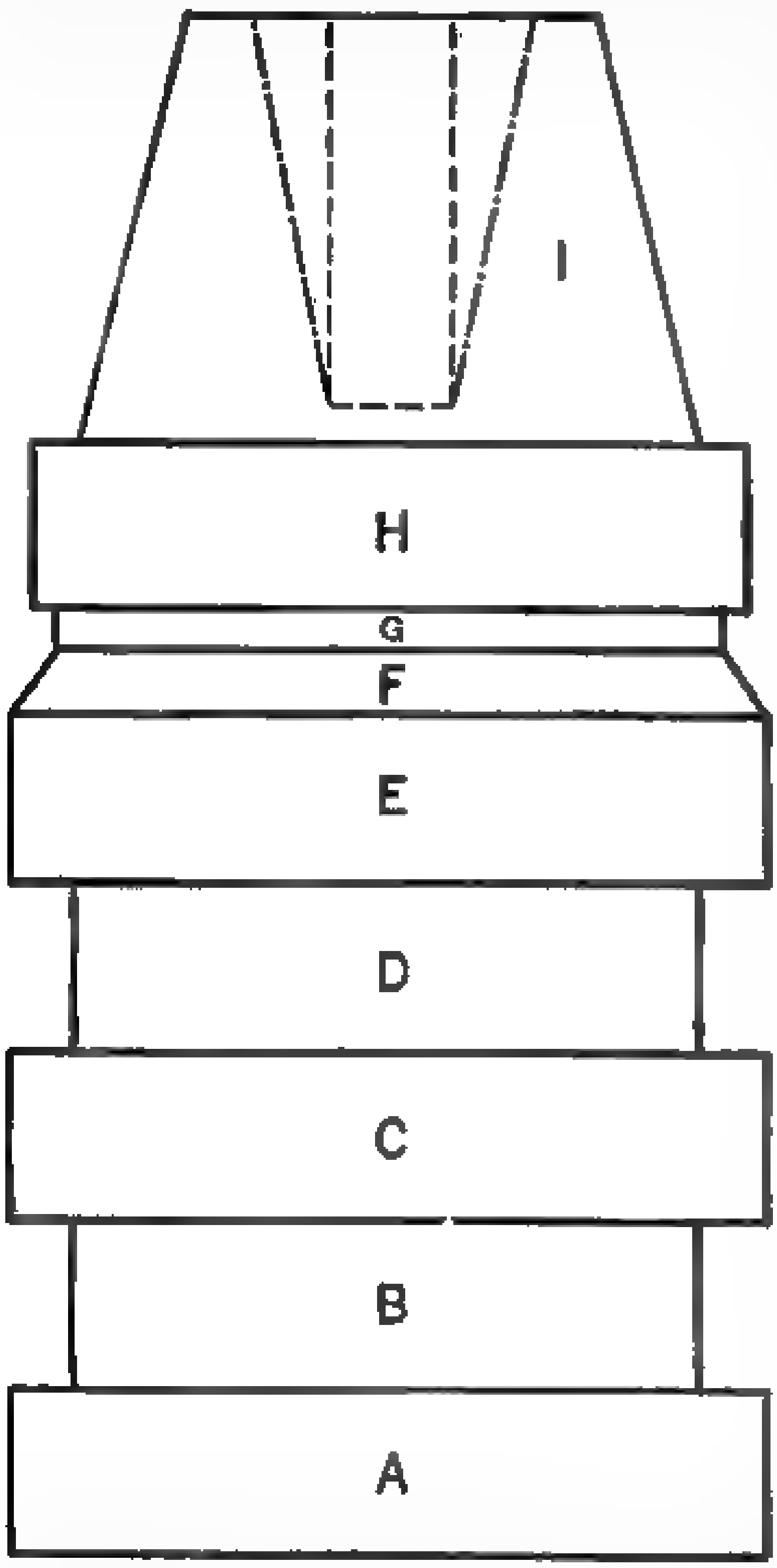
Still another method of making moulds is possible. The writer has had several moulds built to order by the method in question, but the average mould maker cannot do it. The method is "lathe cutting" and requires the services of an expert machinist. The blocks are clamped together after facing, and mounted in a jig solidly held within the jaws of a lathe chuck. A cutting tool is clamped in a lathe tool post and the jig with its blocks is rotated at cutting speed. The lathe cutter is hand-fed into the revolving blocks, and finished size is purely a matter of skill of the operator. Of course, certain special shapes of cutters are used, ground to give definite contours. This problem is not too great for a good machinist, but it is very easy to bungle the job. Lathe cutting of mould blocks in this manner is more economical in many respects, since it eliminates the necessity of grinding a special reamer or cherry. The latter costs from $15 to $20 alone, plus the cost of making a mould.

For pure experimental work, lathe cutting of moulds is unusually satisfactory, as certain bullet dimensions can be changed at will through the simple process of recutting the blocks. If you use a cherry-cut mould, the alteration of a groove width or depth by a matter of .003 inch will mean the regrinding of a cherry or the making of an entirely new one. Hence the slightest change will mean the price of a new cherry. Bear all this in mind before you begin designing special bullets for your private use, and do not berate the mould maker because he quotes you an "excessive" price for the initial mould. Of course, once the cherry is ground, many moulds can be made from it, but the man who designs it *pays the price of the cherry,* which usually remains in the possession of the mould maker. He may add it to his line—they usually do—but it will be a long time before a new bullet becomes sufficiently popular to be profitable to the maker, and the designer can never hope to get a penny of his initial cost back. Therefore, if you plan to design bullets, you might as well consider in advance that your heavy initial cost is pure no-profit "experimental expense."

Bullet Designing. In designing bullets, how many grooves should one use, and how deep should they be? Any form of answer to this question would only create a never-ending argument. It all resolves itself into the caliber, use, velocity planned, barrels in which it will be shot, alloys to be used, and many other things IF LABORATORY PERFECTION IS TO BE OBTAINED. However, laboratory perfection is one of the unknown quantities in handloading. One man's idea may be sound on the subject, while another experimenter, using these same ideas in a somewhat different cartridge, will find a tremendous difference in results. Most of the bullets on the market today—and this of course means the moulds for them—are more or less time-tested. They have been widely shot, and many a shooter finds that they are more or less susceptible to variations. In this, cast bullets have been, are, and always will be more variable in results obtained than metal-jacketed types, having critical points practically beyond theoretical explanation.

Grease grooves and driving bands have a reasonable requirement as to width: they should be approximately equal in area, although two-thirds driving band and one-third grease or lubricating area is quite satisfactory in many bullets at normal velocities. Too narrow driving bands lower the velocities possible, as the bullets are inclined to strip. The same is true if too deep a grease groove is used—the driving bands stand up "tall" and are weakened considerably. The rotational twist imparted by the rifling, plus the resistance of the bullet through its inertia, is inclined to mash or "tear down" these tall driving bands. Grease grooves should, however, be deep enough so that a certain amount of lubricant is found in recovered bullets. Number of grooves? Fight it out among yourselves. In revolver bullets the writer uses both one and two, and believes that usually one is more reliable, less likely to strip and lead the barrel at high velocities—which is just the opposite of the theory of another veteran experimenter. If you must design a bullet, secure the illustrated catalogs of various mould makers, choose the best-looking

bullets therein, and first order some of them to try out in your pet hardware. If you can find weaknesses, then design your bullet to overcome these weaknesses, using the best features of all bullets you have tried rolled into one. Thus you don't acquire a new and expensive mould which is im-



Method of figuring the cubic contents of a bullet (see text)

properly fitted to your needs. Remember that the "scrap value" of a tailor-made $25 mould is less than one cent.

There is one thing well worth bearing in mind in designing a mould, however. Beware of sharp corners. Several mould makers have built blocks to order for the writer, but of the lot, only two more or less obscure makers have been able to execute those orders *accurately*. Hence it is not out of place to "give the boys a hand" for their skilful workmanship and careful attention to detail. Experimental work for the .357 MAGNUM cartridge, which began as a super-powered .38 Special, was all conducted with a Sharpe 146-grain hollow-point bullet and a similar form in solid and weighing 157 grains. My very good friend H. P. Austin of the Firearms Specialty Works, Box 634, Jamestown, N. Y., built these blocks to the writer's specifications, and by that I mean to make it clear that the resultant bullet was not *similar* to the bullet designed on paper; it was IT. Diameters mean something to this firm. They cut all measurements the way I wanted them, and they deserve full credit.

Another newcomer to the field of mould-making is George A. Hensley, 2692 E Street, San Diego, Calif. Hensley built moulds for the .44 Sharpe hollow-point and solid, and here too we found perfection of workmanship. This bullet was designed with round-bottom lubricating grooves, and the cherry Mr. Hensley ground up follows the paper measurements properly, since the designer definitely planned his bullet metal and allowed for the inevitable shrinkage of the metal in the casting process. This mould has the nose portion of the cherry slightly dulled or "rounded" instead of a straight bevel. A faint bevel has been given to the base. This makes it very easy to drop bullets from the mound in casting, and this feature should be carefully considered as one of the necessary refinements in the manufacture of a newly designed mould. The base bevel is not as great as on most Belding & Mull bevel-base bullets, but is along the same lines—a worthy feature.

In designing new bullets, it is comparatively simple to determine their eventual weight if one is reasonably good at ordinary mathematics and doesn't mind the hard work of figuring cubic contents. These figures should be carried to at least five or six places beyond the decimal point in all steps or reasonable accuracy cannot be determined. Method of estimating the weight can readily be determined by obtaining the cubic contents of the accompanying analytical sketch. The cubic contents of each section, marked A, B, C, D, E, F, G, H, I, should be figured separately and added up. Better accuracy can be obtained by carrying these figures as much as ten places beyond the decimal point—and that means the use of more than one or two pieces of scrap paper. Then the hollow point, if it has one, can have its cubic contents figured carefully and the result can be deducted from the total. This will give the *cubic contents*. Further calculations are based on the knowledge of the weight of the alloy per cubic inch. These data will be found in the tables of the appendix and in Chapter XXXIV.

Bear in mind that there are two very important features of bullet design—performance of the finished bullet, *and* the problems of casting. Bullets with sharp, square-corner grooves and driving bands may perform as well as bullets with rounded corners, but they do not drop from the mould so readily. Hollow-point and hollow-base attachments also slow up the casting to no small degree, and if improperly designed will make the work unusually difficult. Cavities for hollow points can be of almost any depth desired, and their effectiveness at any given depth is controlled entirely by the velocity at which they are traveling *when they arrive.*

This latter point is worthy of still further consideration. For 50-yard shooting, it makes little difference about the *muzzle* velocity of the projectile—it is the *remaining* velocity which counts. At the same time the muzzle velocity is of extreme importance at longer ranges, since it entirely controls the *rotational velocity* of the bullet. This rotation or spin has much to do with bullet expansion, and the fundamental theory of its effect should be understood. For instance, a bullet from a 12-inch twist at 1500 f.s. muzzle velocity is *rotating* once in every foot of travel, or 1500 revolutions per second (r.p.s.). This rotation does not slow down nearly as fast as the velocity, as it is dependent only on inertia, the "skin friction" of the bullet on the atmosphere, and similar deterring forces which can be figured only through a thorough understanding of higher mathematics *plus* a knowledge of the atmosphere encountered, temperature, barometric pressure, etc. Generally speaking, these elements may be discarded and at most hunting ranges one can roughly figure on the muzzle rotational speed as the effective remaining r.p.s.

Hence the bullet, while being rotated primarily to keep it traveling nose on, also owes much of its destructive effect to the "flywheel tendencies" of the spinning mass. When this comes in contact with any object, the spinning is unbalanced and it upsets through centrifugal energy released, causing collapse of the walls. On hollow-point bullets, the cavity spreads outward through the trapping of air or animal juices in this pocket, forcing the nose of the bullet to expand outward. The spin, through its centrifugal effect, continues this "opening" process, and if the spin or rotational speed is great enough, a small portion of the bullet nose will be thrown off, thus completely unbalancing the forward-moving mass. The result is a shattering of the portion of the nose clear to the bottom of the cavity, and small pieces of bullet nose will be thrown off tangentially in a forward direction to complete the destructive effect of the wound. Thus one can determine by actual experiment just what rotational speed is necessary to "mushroom" a bullet, and what speed is necessary to "shatter" it. Shattering can be accomplished in any bullet if the rotational speed is great enough.

This explains why many of the old-time rifles, shooting long heavy almost pure lead bullets with hollow points, mushroom like those beautiful specimens you find illustrated in old catalogs, while your own experimental work with modern rifle bullets shows few of these umbrella-type mushrooms and more shattered bullets. It also explains why bullets of metal-jacketed types—either of soft or hollow point—cannot be depended upon to mushroom at normal revolver velocities, while as rifle bullets they are exceedingly effective. The old lead-bullet rifles had their barrels rifled at a twist rate of not less than one turn in 18 inches and in many cases as slow as one turn in 42 inches. At a muzzle velocity of 1800 f.s., the 18-inch twist spins the bullet at 1200 r.p.s. while a 36-inch twist spins it at just half that speed or 600 r.p.s.

Considering revolvers, automatic pistols and other handguns, we find that Colt barrels are rifled in centerfire calibers one turn in 16 inches, while in Smith & Wesson calibers the .32/20 has one turn in 12 inches, the .45 Model 1917 (.45 ACP caliber) one turn in 14.66 inches, all .38s one turn in 18¾ inches, and all big bores such as .44/40 and .44 Special, one turn in 20 inches. In a .38 caliber, therefore, a bullet driven at 1000 f.s. rotates at 750 r.p.s. in Colt barrels, and about 635 r.p.s. in S. & W. barrels. It isn't so much the velocity which causes them to fail to expand as it is the unusually low rotational speed and consequent lack of centrifugal energy.

This centrifugal energy and the shattering effect of any impact was clearly demonstrated to the writer a number of years ago while on an excursion into the woods where a portable lumber mill was functioning. A bright chap, who had an unusual penchant for doing foolish things, tried his .38/55 at a 36-inch saw blade with several shots. The lead bullets "pinged" nicely and gave him quite a thrill, despite my admonitions. He examined the blade and found that they hardly dented it at the 50-yard range. At a later date he tried it on another blade and shot through it. Then one day came the big thrill. He tried a shot at that same blade while it was turning over at idling speed with some lumber operators about fifty feet away. The excitement was over in a moment—and when the pieces had stopped flying, I found a

section of that saw some 18 inches long by an irregular 10 inches wide projecting *through* a 10-inch spruce tree over 60 paced yards from the scene. No one was hurt, but it cost that foolhardy experimenter considerably more than the price of a new modern sporting rifle just to repair the damage, plus a $50 fine in a small-town court. The rotation of that saw under the impact of the bullet was temporarily disturbed so that the "flywheel" effect caused it literally to "blow up" through release of the centrifugal force built up.

What should the shape of the cavity be? This is a problem in hollow-point construction worth more than passing consideration. In the writer's experimental work with handgun hollow points he has found that the shape of the cavity has much to do with its performance in the field. *Any* shape of cavity can be made to expand *some* of the time, but the satisfactory bullet performs properly under unfavorable conditions as well. The semi-conical cavity performs well under certain conditions where velocity and rotational speed are in reasonable proportion, but when velocity falls off, the low rotational speed limit of revolver bullets does not permit of the accumulation of sufficient centrifugal force to *dependably* upset it. One of the Experimental .38 Special bullets of the writer's design used this type of cavity, as exemplified in the Keith bullets designed by my good friend Elmer Keith of North Fork, Idaho. It worked at short ranges but was not fully reliable. Accordingly on the "Field Expedition" in which Major Wesson and the writer experimented with the early stages of the .357 Magnum, a different type of cavity was tried. This was a straight cavity .125 inch in diameter (1/8 inch) and .375 deep. At velocities around 1000 to 1100 f.s. this bullet mushroomed excellently. At 1200 f.s., 1300 f.s., and on up to 1500 f.s., this bullet literally "blew up," creating very destructive wounds. On small animals such as big rabbits, chucks, etc., it actually tore them apart. One rabbit shot at about 50 yards, paced, was knocked three feet by the blow, and was torn to pieces, the bullet destroying one entire side, hip, hind leg, and abdominal cavity. Squirrels were destroyed almost beyond identity.

Two shots were fired by the writer at fair-sized cats—two bay lynxes, a 26-pound female and a 31-pound male. One cat was loose, the other in a trap a few days later. The bullet in both cases struck in the chest, running longitudinally, the second kill being made out of a trap and at a distance of about 20 feet with an effort made to place the bullet so as to duplicate the direction and path of the first kill. In both cases the bullet made a small entrance hole, began immediate expansion within a penetration of an inch, and in five inches had shattered. Both cats died without a struggle or even a twitch of the tail. Death was as instantaneous as any that the writer has ever seen caused by bullet. There was just a clenching of the jaws for a fraction of a second, a muscular tremble, then relaxation. The answer was *nerve shock*. Autopsies were performed on both animals. In one the left front shoulder joint was pulverized, pieces of the bullet were found in the abdominal cavity, and the solid-base portion, together with a section of the shoulder ball joint, was found imbedded in the bone at the base of the spine. There was no exit hole in either case, and practically no external bleeding. The other cat was similarly damaged, although the shoulder joint was untouched. Pieces of the breastbone and shattered bullet were found in the abdominal cavity and the lungs, while the base portion of the bullet was recovered in the right hip muscles. Deer, shot through the neck with this bullet, received terrible wounds with pulverized bones due to the shattering of the bullet nose; but in the two cases we studied, no bullet particles could be found, and the exit holes were better than two inches in diameter. A horse, killed because of disease, died quickly from a neck shot which broke the spinal column, and here also the bullet made a two-inch exit. No autopsy was performed, since the writer was not anxious to experiment with the disease in question. . . . All of which clearly proves that revolver bullets can be made to expand, despite reports of many writers to the contrary, but the type of cavity has much to do with their performance.

The idea of mushrooming bullets in the cast variety is by no means recent. The writer's earliest experiments with handloading, including casting from a bullet mould built on the end of an Ideal combination loading tool for the .38 Long Colt, included experiments too numerous to mention. We tried the idea of two-metal bullets, in which a special mould was used to cast a pure lead nose portion with a wedge base. This was then inserted in the cavity of a regular bullet mould designed for it, and an alloy of proper hardness poured into the cavity, thus creating a bullet of 1-10 or 1-15 bullet metal with a soft lead nose. We can't recall that this experiment was particularly successful, although it worked after a fashion, and the bullets did expand better than all-alloy bullets cast in the same mould.

Another idea which we "originated" in 1919 was found to have some merit, but after we had played with it awhile we found that the great and origi-

nal invention was pictured in detail in the Ideal Handbook #13 published in 1901. We split the nose of bullets, either by using a fine jewelers' hacksaw or by inserting a fine sheet of thin bond paper between the halves of the mould at the nose portion, and then pouring in the lead. Of course this does not permit the blocks to close tightly, with the result that a thin fin forms on the sides of the bullet; but this can be trimmed readily with a knife, and the resizing die does the rest. Such a bullet is not perfectly balanced, but very few cast bullets are, so one doesn't lose much. This idea, we thought, was original, but read what the 1901 Ideal Handbook has to say about it:

"A very simple method of casting the split bullets is to place a thin strip of paper between the halves of the mould. If you desire to completely sever the point of the bullet, let the paper project beyond the nose, otherwise locate the strip slightly to the rear, which will leave the nose unmutilated in flight. This works best, should the bullet open in flight. These bullets have been tested. Their accuracy is not impaired, and with a little experimentation the shooter may vary the length of the split to get the best results. To test the tearing qualities of this bullet, set up three or four (or as many as you like) one-inch pine boards, about four inches apart, at a distance of 50 to 75 yards, and note the difference of fracture in each board. If the hole is clean-cut in all, they are no better than solid bullets. The first board, however, should show you a clean hole at entrance to indicate that the split bullet did not open before striking."

There are various forms of metal-jacketed "protected" points on the market, many of which are constructed with a covered cavity to prevent entrance of foreign material which might prevent expansion. That idea, too, is not new. This same #13 Ideal Handbook described numerous bullets, including the earliest "Express" bullet of which the writer has record. This was designed by the late A. C. Gould, editor of *Shooting and Fishing,* the pioneer magazine of gun bugs. Known as the "Gould's .45/300 Express" this hollow-point bullet used a straight cavity in a .45-caliber 330-grain bullet. The cavity was filled with tallow. Another method described in this same handbook was written up and discussed pro and con as a new idea by several writers in sporting magazines a quarter-century later. This consisted of a large-caliber cast bullet (most of the hunting bullets at the turn of the century were large calibers) with a cavity of proper size and depth to hold a .22 Short rimfire *fired* cartridge case. The cavity permitted of flush seating, and the soft copper case served as full protection for the cavity in flight or in handling. It is quite possible that this is where Sir Charles Ross, noted Canadian arms and ammunition designer, first acquired his idea for the "Ross Copper Tube" bullet, widely copied in England and Germany to this day, and further exemplified in the .30/06 145-grain copper tube loaded and marketed, lo these many years since the war, by the United States Cartridge Company.

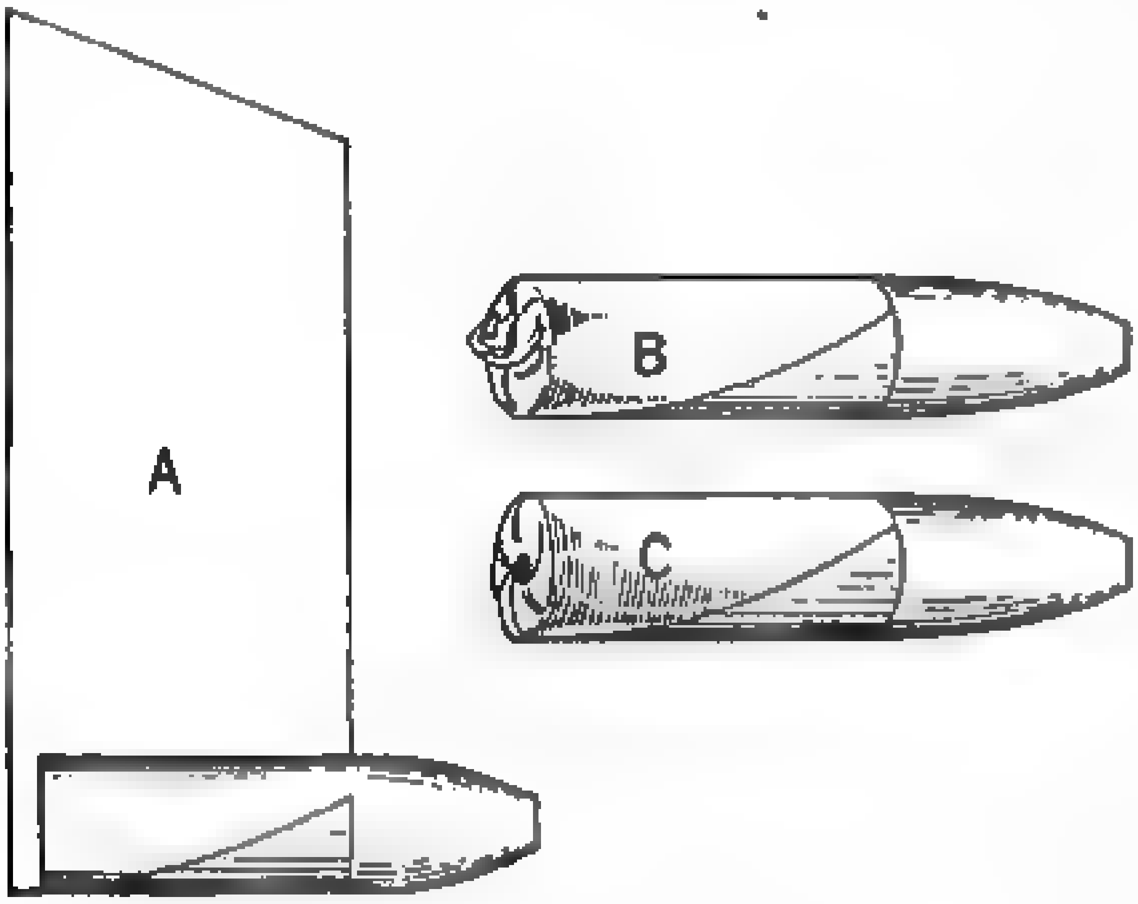
This Gould bullet could also be used with a .22 short blank instead of a fired shell. In commenting on the latter, the Handbook says: "Hunters of elephants, tigers, etc., frequently insert a .22-caliber blank cartridge in the cavity, making the missile explosive. There is always an element of danger about such ammunition. It should never be run through the magazine of a repeating rifle. When dangerous animals are hunted it might impart a feeling of safety to the shooter to know that the cartridge in the chamber of his rifle ready for use was a miniature bomb-shell. The hole in this hollow ball should be of the proper depth and proportion to insure penetration and spread when striking and not fly to pieces, which is commonly the case."

One other extract appearing here is worth reproduction, although not exactly relevant. "As above stated, the term 'express' does not strictly apply to a cartridge that has a hollow-pointed bullet: to wit, the '.38/90/217 Winchester Express,' 90 grains of powder to a 217-grain *solid bullet.* Mark the difference for target shooting where 90 grains of powder would be about right for 500 or 550 grains of lead if shot from a properly rifled barrel." This applies well to modern ammunition, since there has been a marked tendency among our makers in recent years to label many of the high-velocity loadings of a particular cartridge "express" loads. True, most of these have hollow-point bullets, whereas the regular velocity loads *generally* have soft points; but the term "Express" originally referred not to the hollow type of bullet construction, but to the stepped-up velocity with lighter than standard bullets.

Patched Bullets. There is one other form of bullet not previously described as it is now rarely encountered—the paper-patched form. This was extremely popular in its day; the apex of the black powder era. Excellent results were obtained, and the owner of old rifles may desire to experiment with these even today.

Bullets to be patched with paper are smooth, and were supplied by all major factories during their day, either as components for handloaders or as loaded ammunition. They contained no lubricat-

ing grooves and were cast from three to six thousandths of an inch smaller than the standard size. The diameter was increased to the desired size by having a thin paper patch rolled around them, covering about two-thirds of the bullet from the base up. Paper was of excellent rag content, similar to high-grade bond but smooth like so-called "bank-note." Usually it was especially prepared for the purpose in four thicknesses, known to the trade as "extra-thin, thin, medium and thick." The extra-thin ran about .0015; thin was about .002; medium about .0025 and thick ran .003 to



Method of making paper-patch bullets.

.0035. This enabled shooters to decrease or increase bullet size with the smooth bullets which were used unresized. (The paper on which this book is printed measures .0040. In loading these paper-wrapped bullets into the cartridge case, a certain amount of the paper wrapping projected from the case mouth—usually from ¼ to ½ inch—thus necessitating careful handling.

Ordinary factory paper-patched bullets had *two* wraps of paper around them. The patch was cut in length for each type of bullet so that the ends did not lap over each other, but practically butted against one another, thus eliminating an ugly and unbalanced "ridge." The front and back edges of the patch were cut square with the bullet case, but the ends were trimmed at an angle of from 40 to 45 degrees, so that the lap would not be parallel with the angle of the rifling. This system held the joints securely without the use of an adhesive.

The handloading experimenter who acquires an old Ballard, Bullard, Sharps, Remington, Winchester, or other excellent specimen and desires to experiment with paper-patched bullets will have to "roll his own" as they are no longer manufactured. The best method of doing this is first to cut a strip of paper the width desired and have it long enough to wrap around the body of the bullet *three* times. Roll this strip of paper firmly around the bullet, but have the base project at least one eighth inch or more beyond the base of the bullet itself. When it is rolled, hold the nose of the bullet from you, and with a razor blade or other sharp instrument cut through *all* thicknesses of paper *except* that base overhang. Commence the cut at a point near the base, rotating the bullet slightly to secure the desired angle. Carefully unroll this strip and the two full-sized inner pieces of paper held together by the uncut part will represent, when put together, the shape and length of the patch desired. Discard the surplus, and with these two pieces as a pattern, cut another piece of paper *exactly* their size, maintaining the proper angle on the ends.

This pattern should then have one end trimmed about 1/64 inch short without changing the angle, thus preventing the possibility of the ends overlapping. Use this patch as a pattern and save it. If you intend to use it many times, a thin sheet of brass shim stock or other thin metal may be cut from it as a pattern or template. Finished patches should be cut only as needed, thus eliminating ragged edges from careless storage. Then comes the application to the bullet, a seemingly difficult task, but quite simple once you learn the trick. Patches should never be applied *dry*. Wet two towels, wring out surplus water gently, and spread one out carefully on a level surface. The patches are then placed on this towel and covered with the other damp cloth, remaining in this "sandwich" for several minutes to half an hour, depending on the amount of moisture in the cloth. They should be quite damp and free from "wrinkle" characteristics. Some loaders dip them in water, wetting them thoroughly and then removing the surplus between two pieces of blotting paper. The damp paper is then wrapped smoothly around the bullet; because of its limp condition it will hug all contours snugly. Patches must not be too wet, and no mucilage or other adhesive should be used, as the patch must *not* stick to the bullet. Paper patches are supposed to blow off the bullet almost as soon as the projectile leaves the muzzle.

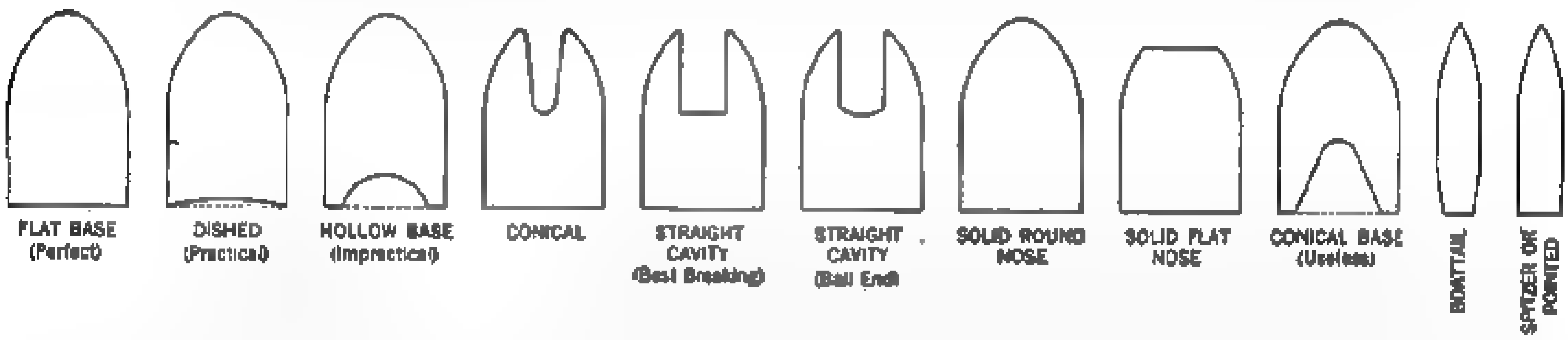
Rolling on the patch is an art in itself, yet one readily acquired with a little painstaking practice. Lay the patch on a smooth surface with the point of angle toward and from you (see sketch). Have the point of angle toward you *to the right*. Patches are rolled on with ease if a short section of board is used, squarely cut on one edge, and the point

toward you is left hanging over the edge to permit of easy grasping. Place the bullet squarely on the patch, base to the left, letting as much of the patch project beyond the base as you desire. There should be a reasonable amount—from ¼ to ⅜ inch appeals most to the writer, but this must be controlled by the size you planned when the patch was cut. Pick up the point toward you as per sketch, hold it wrapped around the bullet with one finger, and then push the bullet up over the patch, thus rolling it around the lead cylinder. If not rolled true, unwrap and try again. This is a job which has always been done by hand, even in the factories. At the ammunition plants girls rolled these on, and many girls were capable of patching 12,000 bullets each per working day.

Cast paper-patch bullets have flat bases, while the factory type has a cavity. A properly patched bullet has the paper covering extend over the base of the bullet a distance equal to about ⅜ the diameter of the bullet. This overhang is grasped in the fingers while moist and twisted tightly, the factory girls then pressing this slight paper "tit" into the cavity of the bullet base. The flat-base bullet without a cavity—which, of course, was the most commonly used by handloaders—had the patch project only *one-third* the diameter of the bullet. The edges of the paper tube were pressed over the base while still moist by the fingers, and the entire bullet then pressed base-first against some flat surface. When either type dried, the paper shrunk tightly into position, thus preventing inaccuracy and loading problems due to loose patches.

There was still another type of patch used by handloaders and known as the Chase patch. This was a single lap designed by some handloader and was never furnished ready-cut as were the standard two-lap patches. The Chase patch was cut with square edges, the joint butting up smoothly, and was designed for direct loading into the barrel with dry patches. It could not be loaded into the shell in "fixed" ammunition, and required a special tool made by Ideal and other firms of the day and known as the "Ideal Ball Seater." This consisted of a dummy shell with a hollow core and plunger. The patch was formed into a tube, inserted into the mouth of this dummy shell or seater, and the bullet dropped into the tube and pressed home to proper depth. The core was then pressed forward to "crimp" the base of the paper tube on the bullet and the entire unit inserted into the chamber of the barrel. The dummy shell or seater, mounted on a handle, was then freed of the bullet by pressure on the core, thus forcing this bullet to seat in true alignment into the leade of the rifling. A blank cartridge, with the full charge of powder sometimes held in place by a card wad, was then inserted in the chamber and the arm fired. The loading process was slow as compared with present-day methods, but records equaling those of Pope-made barrels with the Pope system of muzzle loading have been made. Some shooters used a card wad over the powder charge, others pointed the barrel muzzle up while the shell was inserted in the chamber, and used no wad. Still others used a thin card wad over the powder charge covered with a thin cake of some type of bullet lubricant such as Japan wax or tallow.

BULLET BASES AND NOSES



Just what can be done with a properly loaded paper-patch bullet? Nearly half a century ago—on July 18, 1891—Francis J. Rabbeth, experimenter, shooter, and writer of that day under the pen name "J. Francis," performed the officially recorded feat of fifteen consecutive shots into a 2-inch circle at 200 yards at the Walnut Hill Range, near Boston, Mass. You ultra-modern riflemen with your heavy barreled International Match Springfields, think that over a bit. In this shooting Mr. Rabbeth used a .38/55 Ballard and the 330-grain Rabbeth paper-patched bullet. This type of bullet had a cylindrical body with a rounded and flat tip nose cast in a cylindrical adjustable mould, not swaged. He used 55 grains Hazard Fg black powder, no wads, bullets patched by the Chase method with a single thickness of .00225 paper. Bullets were seated into the rifling 1/32 inch ahead of the shell by means of the Ideal Ball Seater. After each shot he cleaned the barrel with a wet bristle brush, pushing

it through with a rod having a snug-fitting wiping rag attached. This rag is pushed clear through the barrel from the breech and drawn back. No second wiping. No oil or other lubricant was used. The performance record speaks for itself.

Ideal can supply some of these old moulds for paper-patched bullets; therefore, the experimenter who desires to try out the old smoke stick with black powder, King's Semi-Smokeless, or the two true bulk smokeless powders, Du Pont Schuetzen and Rifle Smokeless #1, can experiment not only with lubricated cast bullets but also with the accurate patched-paper variety.

A couple of years ago the writer fell heir to a batch of Swiss military paper-patched bullets averaging about 212 grains weight. This bullet happened to be the old 7.5 mm. Swiss military bullet in use many years before they adopted the boat-tail bullet—"streamline," they call it. These bullets had an overall length of 1.125 inches and a cupro-nickel plated *steel* jacket over the bullet tip, giving the appearance of a round-nose full-metal-jacketed paper patch. The bullet, however, had the metal nose .450 inch long and a cylindrical grooveless body about .70 inch long. A slight, round bottom cavity contained the twist of the two-layer paper patch pressed into it. This patch of a yellowish linen-content paper .002 inch thick covered all traces of the lead body. The paper was originally lubricated with vaseline, but at the time I acquired those bullets they must have been at least 25 years old, and accordingly lacked lubrication.

I tried these with Du Pont Rifle Smokeless in a Krag barrel measuring .310 after checking the bullets to find that they measured .325 with the paper patch and .317 without. The original Swiss load called for a velocity of 1920 f.s. from a 23.33 inch barrel, and my testing was in a very accurate 24-inch Krag sporter barrel. The best group I could get at 50 yards, prone with rest, was about 2½ inches, and patchy grouping at that. Accordingly, I "tore down" some of these bullets and found them to be of very poor construction, irregular shape bases, etc. The paper patches were slid from the bullet body without damage, and a few bullets selected for perfection of base, and the same load tried again. This must have closely approximated the standard velocity. Result with two ten-shot groups at 50 yards, prone, forearm and elbow rest, ¾ x ¾ and ¾ x ⅞ vertical. Pleased with the results, I fired the remaining ten perfect bullets at 100 yards in two five-shot strings, got one 1¼ x 1⅜ vertical and 1½ x 1½. The paper-patch bullets were a success.

The history of this Swiss bullet is decidedly interesting because it can be verified, whereas the history of the target paper patch types used in America is shrouded in the customary lack of actual evidence. Major Rubin, co-designer of the present Schmidt-Rubin rifle, was seeking a smaller caliber to replace the .41 Swiss rimfire and later the central fire cartridge identical in shape, and used in the Vetterli match rifles. In the mid-eighties he began official experiments, but was "beaten to the draw" by France with its 8-mm. Lebel *Balle D.* Major Rubin, however, explored the possibilities of the rimless cartridge case and eventually developed the present 7.5-mm. Swiss having a diameter of .295. Most barrels, however, ran about .308 to .309. A compressed bulk semi-gelatinized smokeless powder was used, and the paper-patched bullet developed with the steel nose to insure penetration of the practically pure lead-bullet body. For many years this bullet was the standard—until its official replacement by the present steel-jacketed 174-grain boat-tailed bullet, similar in appearance to our own Mark I Service bullet, adopted in 1909 for the Schmidt-Rubin *long model* with a 30.8-inch barrel. The latter bullet was given a muzzle velocity of 2720 f.s., equal to about 2550 in a barrel of the Springfield length.

It will be seen, therefore, that paper-patch bullets are capable of being shot, not only in rifles of the Ballard class, but also in modern small bores. The bullets should be carefully seated in the mouth of an unresized cartridge case. Any effort to resize will result only in destruction of the paper patch. They can be used with smokeless powder, even of the "dense" type, and with suitable experimentation, excellent loads can be developed. Here is a field for the experimental rifleman who likes to "tinker around." Any bullet can be used if of proper size, but it should be soft—not over 1 to 30 lead and tin. As in other fields of handloading, there is a lot of fun in playing with "paper patches."

Still another form of patched bullet not generally known in this day and age is the "wire patch." This bullet was patented April 11, 1899, and for some years was manufactured by the National Projectile Works of Ontario, California, a firm which was succeeded by the National Cartridge Company of Napa, California. This wire-patched bullet was quite an oddity. Why it did not have a longer life I do not know, for it has many interesting features. The bullet, of course, was special in design and was intended to replace metal-case bullets. Literature in my files published about 1907 by the National Cartridge Company severely

criticizes the metal-jacketed bullet and its great wear on the then soft steel barrels. The wire patch bullet was cast undersize with a number of special threads around the cylindrical body extending up nearly to the point. Around the bearing surface in these grooves was wrapped special waxed double cotton-covered copper or bell wire. The wrapping was extremely tight and in every case was machine wound, the ends being fastened by means of crimping into a special groove of the bullet. The base of the projectile was covered with a gas check of copper. According to a long list of testimonials it seems that this lubricated bullet performed perfectly, permitted normal or even slightly higher speeds than factory standards *with jacketed bullets,* did not strip, and upon recovery the majority of bullets appeared to mushroom as perfectly as only a soft-lead type can. At the same time they still retained the insulated wire.

Claims of the manufacturers indicate that this wire-patch bullet did not injure the gun; cleaned and lubricated the barrel with every shot; completely filled the grooves of the rifling, preventing gas cutting; greatly reduced the friction and thereby increased the velocity with the reduction in pressure; and could be used in any style of gun, slow or rapid twist, with black or smokeless powder. The manufacturers, of course, claimed that they were highly accurate. These bullets were made in .30/30 caliber, 160 or 170 grains; .30/40 Krag, 220; .30/06/150 and 180; .303 Savage, 180; .303 British, 215; .32/40/165; .32 Win. Special, 165; .32 Ideal, 150; .32/20/115; .33 Win., 200; .38/55/255; .38/40/180; .38 Long Colt, 150; .35 Win., 250; .38/56, .38/70, .38/90 all 255 grains; .38/72/275; .40/65/260; .40/70/330; .48/82/260; .405 Win., 300; .44 Smith & Wesson Special, 246; .45/70 Government 405 and .45/70 300 grains. Thus it can be seen that they covered the majority of the then popular calibers.

These bullets sold for approximately the same as metal-case varieties of that day and were supplied either as components or in cartridges loaded by the National Cartridge Company. The idea seems thoroughly sound. It probably died a natural death with the introduction of nitrocellulose powders and better gun-barrel steels, which greatly increased the useful life of gun barrels.

THESE WIRE-PATCHED BULLETS

Following the publication of the data on the old National Wire Patch, reprinted above as it appeared in the original edition of this volume, much new data on the subject, plus information on the revival of the wire-patch idea by handloaders has come to light. This information is covered in the chapter "Bullet Developments" in the supplement to bring the subject up-to-date.

—The Author

XI

METAL-CASE BULLETS—TARGET AND HUNTING

THE handloader today is "sitting pretty" on the subject of metal-case bullets. He can secure them from countless sources and can spend any desired amount of money up to three cents each for his various projectiles. He can shoot .32 Automatic Pistol bullets in a .30-caliber rifle, also the 7.63-mm. Mauser Automatic Pistol, the 7.65-mm. Luger Automatic Pistol, the .32/20, various weights of Soft Points, Hollow Points and Full Jackets, as well as many others, all in addition to those designed particularly for the cartridge as loaded by various factories. The combinations, one might say, are practically unlimited.

Any handloader who has been at this game for a number of years will enjoy looking back. At the close of the World War handloaders could purchase for the .30/06 Springfield cartridge, a 150-grain cupro-nickel-jacketed bullet, a 180-grain and a 220-grain, costing about three cents each. Then came the dumping of war surplus. The old 150-grain cupro-nickel bullet was spread out over the United States in millions, and target shooters could pick them up for as low as $3 or $4 per thousand. The handloader was still limited. He shot factory ammunition or he shot the two .30/06 bullets, rarely giving any consideration to the third member of the tribe—the 220-grain.

In this day and age the handloader continues the inquisitive experimentation started by handloaders of a couple of decades ago. However, he has knowledge at his disposal which was at that time unavailable. He can buy bullets from every arms and ammunition manufacturer in calibers not previously sold to the handloading public. He can buy bullets for one caliber to be shot in another. He merely has to know the size, shape and diameter of the bullet in question and then figure out how well it will fit his barrel.

Types and Makers. Metal-jacketed bullets are made in this country by the Winchester Repeating Arms Company of New Haven, Connecticut, Western Cartridge Company of East Alton, Illinois, Peters Cartridge Company of Kings Mills, Ohio, Remington Arms Company of Bridgeport, Connecticut, and the United States Cartridge Company of New Haven, Connecticut. In addition, excellent bullets in certain calibers are made for handloaders by R. B. Sisk, Iowa Park, Texas, and by the Western Tool and Copper Works of Oakland, California. These firms offer the reloader a choice of pointed metal-jacketed bullets, of full-jacket type, various shapes of round noses, also in full-jacketed types and pointed or Spitzer soft-point and protected-point varieties. In addition, they also make soft points with a tiny exposed soft nose and with long exposed lead noses. You can obtain hollow points which have but a trace of a cavity in a pointed nose, or medium cavities or large cavities. You have semi-pointed, round-nose hollow points, and you have long exposed soft points having a cavity. You can obtain bullets with a long barrel bearing or with a short bearing, and you can thus load any caliber through a practically unlimited range of velocities to meet any particular demands you may desire.

A jacketed bullet is actually an ordinary lead-alloy bullet with a covering of a much harder metal, designed, of course, to permit of velocities far in excess of those possible with ordinary lead bullets. Copper or gilding metal jackets are by far the most common ones today, and it is quite possible that within the next few years no more cupro-nickel jackets will be manufactured.

There are available to handloaders numerous types of jackets. Imported bullets are on the market in this country, although, of course in limited quantities. The experimenting handloader very frequently spends a lot more money than it may be worth merely to purchase freak bullets. Some of our importers send to England, France, Belgium and Germany to get certain bullets for insistent handloaders. Delivered to his home in Squeedunk, U. S. A., said bullets invariably cost five cents each, sometimes more, and may or may not be equal to American bullets costing one-fifth of that amount. That point is not worth arguing If the handloader wants to experiment, he should be permitted to do so, and if he knows that he is going to spend money in his experimental work, let him enjoy it. The writer, too, has imported bullets from England and Germany and has conducted numerous experiments. On his shelves as this is being written are at least three different German bullets capable of being loaded into .30/06

cartridges and some nine or ten suitable for the 7-mm. There are numerous others from England. In fact, we have imported from Nobel for experimental work during the past fifteen years no less than two dozen different diameters, weights and shapes of bullets.

A jacketed bullet is known under numerous names. Foreign countries refer to it as a "metal envelope," "steel envelope" or "hard envelope." In England they speak of "metal-covered." In America different ammunition makers refer to these bullets as metal-patched, metal-cased, and metal-jacketed types. Suit yourself. Every newspaper or fiction-story magazine you happen to pick up describing a shooting refers to "steel-jacket" bullets. Of course, the reporters or writers may be correct in their designation. The author has had many visitors in his laboratory who have picked up a metal-jacketed bullet of resplendent red-gold color which the most ardent dub should label "copper," and yet they exclaim: "Ah, a steel-jacketed bullet!" Why, when, where or how, we do not know.

It is easy, of course, to understand why a true steel-jacketed bullet should be confused with a cupro-nickel-jacketed bullet or a tin-plated bullet, since the colors are slightly similar; but the true rifleman who uses copper- or gilding-metal-jacketed bullets would feel as hurt to hear someone call them "steel" and be as indignant as he would if someone looked at a nice fancy walnut stock and said, "Ah, what a beautiful piece of pine!" They *look* different.

Steel-jacketed bullets are not commercially manufactured in these United States today. Some writers have gone so far as to claim that they have never been manufactured commercially. Maybe yes, maybe no. The simplest way to test the material of a bullet jacket which will answer the question promptly with a "yes" or "no" if you are suspicious of steel, is to utilize a magnet. If the bullet sticks, that's that. If it doesn't, it may be some new kind of steel which we have never heard of. Anyway, it isn't what we have been led all these years to believe is steel. Some twenty years ago we had a .280 Ross rifle which in those days we shot with the greatest of confidence. With it we had some ammunition manufactured by the United States Cartridge Company, at the time located at Lowell, Mass. This commercial ammunition actually had naked steel-jacketed hollow copper-tube bullets. A sample of this cartridge still remains in the author's collection. However, in handling thousands of cartridges and in examining others belonging to various collectors, we have also seen other commercial steel-jacketed bullets manufactured by American firms. An interesting side light is revealed in a couple of samples in the author's collection in three boxes of .30/40/220 Krag cartridges manufactured in July and September of 1901, two of them sealed at the time this manuscript was prepared. They are labeled and printed "Steel Jacketed." These were commercially made by Winchester. The broken box failed to yield any bullet which indicated that the jackets were steel on being given the magnet test. Although essentially the same, the labels were printed in different type, indicating a different time of loading.

The sealed boxes were opened and examined. All looked identical and yet the magnet revealed that out of one box of twenty, sixteen had cupro-nickel jackets and four had steel jackets, coated with cupro-nickel. The other box held thirteen cupro-nickel-jacketed bullets and seven with cupro-nickel-plated steel jackets; and one of these boxes on break-down tests indicated that they were loaded with conventional Laflin and Rand "WA" powder, while the other box was loaded with Du Pont .30-caliber Annular smokeless.

The primers were entirely different, although they generally appeared the same. One box was primed with ordinary brass primers, while the other used an experimental double-cup primer discovered only through laboratory dissection. This double-cup primer consisted of a thin brass cup with a thin copper cup perfectly swaged inside of it. It was standard size and to all appearances an ordinary brass cup.

The third box had been previously broken and certain cartridges were withdrawn. This box also bore a steel-jacket label printed in a still different manner by Winchester, and was loaded with Peyton (picric acid) powder. It would seem from this that Winchester was simply careless in the early days when the change-over from steel jacketed to cupro-nickel bullets was made, and permitted different batches of these two forms of jackets to be mixed indiscriminately either in the loading or packing operation. Facts are facts.

Frankford Arsenal, however, manufactured 129,000,000 Krag cartridges with steel-jacketed bullets between 1894 and 1900. The steel jackets were thinly plated with cupro-nickel, and most of them had tin-plated cartridge cases.

Cupro-Nickel Jackets. Note that reference to "plated with cupro-nickel." In England and Germany today steel jackets are widely used, but they are rarely used without a protective plating, usually of heavy nature and of either copper or cupro-nickel. High-velocity steel jackets are usually

plated with the latter mixture, while those intended for the so-called "medium-velocity" brackets (1800 to 2300 f.s.) are frequently found plated with copper or cupro-nickel. In England, both methods of plating are used, although gilding metal is usually substituted for the Nobel steal of the Western

Types of foreign metal-case bullets. Left: The original Westley-Richards .303 Magnum capped bullet. Center: The German (DWM) "strong jacket" bullet, heavy gilding-metal jacket designed so that the base portion will remain as a solid slug if the nose portion should completely shatter. This has the typical hollow copper-tube type of protected-point nose construction. Right: Another interesting German bullet, the RWS "H" jacket. Note how bullet jacket is folded in the center as a reinforcement. Also notice hollow copper tube and two-piece core

Cartridge Company's famous "Lubaloy" jacket, which they call "Nobeloy." Many of their best bullets have steel jackets very heavily plated with this "Nobeloy." The majority of their hunting calibers are plated with pure nickel rather than cupro-nickel.

Just what is this cupro-nickel jacket material? If you can find a five-cent piece in your pocket in these days, particularly after you have paid for this book, look at it carefully. You are fiddling with a bit of cupro-nickel. Cupro-nickel is not pure nickel, it is a mixture of copper and nickel with the copper very much predominating, despite the difference in color. The formula is not standard and varies from 60% copper and 40% nickel up to about 87% copper and 13% nickel.

Pure copper is rarely used for bullet jackets, since it is much too soft to stand up under the torsional strains created by the twist of the rifling. The makers use, instead, a mixture known as "gilding metal," often spelled "guilding," or "guilder's metal." This is an alloy varying from 95% pure copper and 5% zinc down to 90% copper and 10% zinc. The latter formula is that used today on Government gilding-metal jackets as manufactured by Frankford Arsenal and by most ammunition manufacturers. A third variation is the patented composition manufactured by the Western Cartridge Company and known as "Lubaloy," meaning "lubricating alloy." Lubaloy is gilding metal plus the addition of a small amount of tin, which gives lubricating or anti-friction qualities to the metal.

Practically speaking, any one of these alloys of steel having a plate of copper, gilding metal, pure nickel or cupro-nickel is bound to foul slightly. Pure nickel fouling is not so bad, but it is inclined to be lumpy. Copper fouling is usually deposited in the barrel in the form of a thin smear, which in turn barely discolors the barrel. The unfortunate part of this is that the copper fouling very often in itself is corrosive, since it starts an electrolytic action between the copper and the steel of the barrel. The net result is that, unless the barrel is properly cleaned, you get corrosion more or less the same as though you originally used the old-style corrosive primer, although the action is by no means so rapid.

A jacketed bullet starts life as a piece of sheet metal, usually of either cupro-nickel or gilding metal. The formula most widely used at present is gilding metal containing about 93% copper and 7% zinc, although Lubaloy—a patented jacket material—contains, roughly, 90% copper, 5% tin and 5% zinc (the exact formula is held secret by the owners of the patent—the Western Cartridge Company). Regardless of the material used for jackets, the process for handling is the same.

As in the cartridge case, these sheets of metal are run through large presses which punch out discs of the material, slightly cupping them. They are then run through a series of dies to draw them to the completed stage and shape. Some firms anneal their jacket material, others do not. In .30 caliber bullets such as the .30/06 180-grain, an average of five draws are made in forming the

jacket. With the round-nose 220-grain types, four draws are usually sufficient.

After the jacket is drawn to its proper length and the surplus metal trimmed, it is ready to receive the core. The latter is either of pure lead or an alloy of lead and antimony; lead and tin; or lead, tin and antimony, depending entirely upon the manufacturer's ideas and preferences. This core material is usually cast into pigs or bars and then "cold-drawn" by placing it in a tremendously powerful press and extruding it through dies in the form of wire of proper diameter. The wire, in turn, is run through automatic cutters which trim it to a suitable length, and the cores or slugs are then ready for insertion in the jacket. In some cases they are roughly bumped into suitable form for this before insertion, in others they are merely dropped into the jacket "as is" and swaged to fill perfectly the hard outer envelope, whereupon the edge of the jacket, which in full metal-jacketed bullets is actually the base, is curled under by still another machine which gives the final shape to the bullet. This curling under effectively locks the core in position. Soft-point bullets are made in much the same manner except that the jacket drawing is flat-ended instead of pointed or round. The core, of course, is inserted from the front of the bullet instead of from the rear.

Types of Expanding Bullets. The handloader who desires to play with expanding bullets for hunting use has a multitude of different types at his disposal. He has the hollow copper tube, as available in the United States Cartridge Company 145-grain .30/06 bullet bearing that title, the bronze point of Remington manufacture which has a pointed wedge-shaped nose in the forward part of the jacket so that no lead of the core is exposed, and he has the Winchester form of protected point in which a pronged tinned copper covering is folded over the pointed soft nose and slid under the edges of the jacket to protect said nose from battering in the magazine or in handling. In addition, he has the various types of jacketed hollow-nose bullets and the hollow soft point; plus the two Peters developments of belted soft nose and hollow point—an ordinary heavy-weight expanding bullet having an additional band of gilding metal wrapped around its waist and properly swaged in position to control the upset—plus the famous Peters "Protected Point."

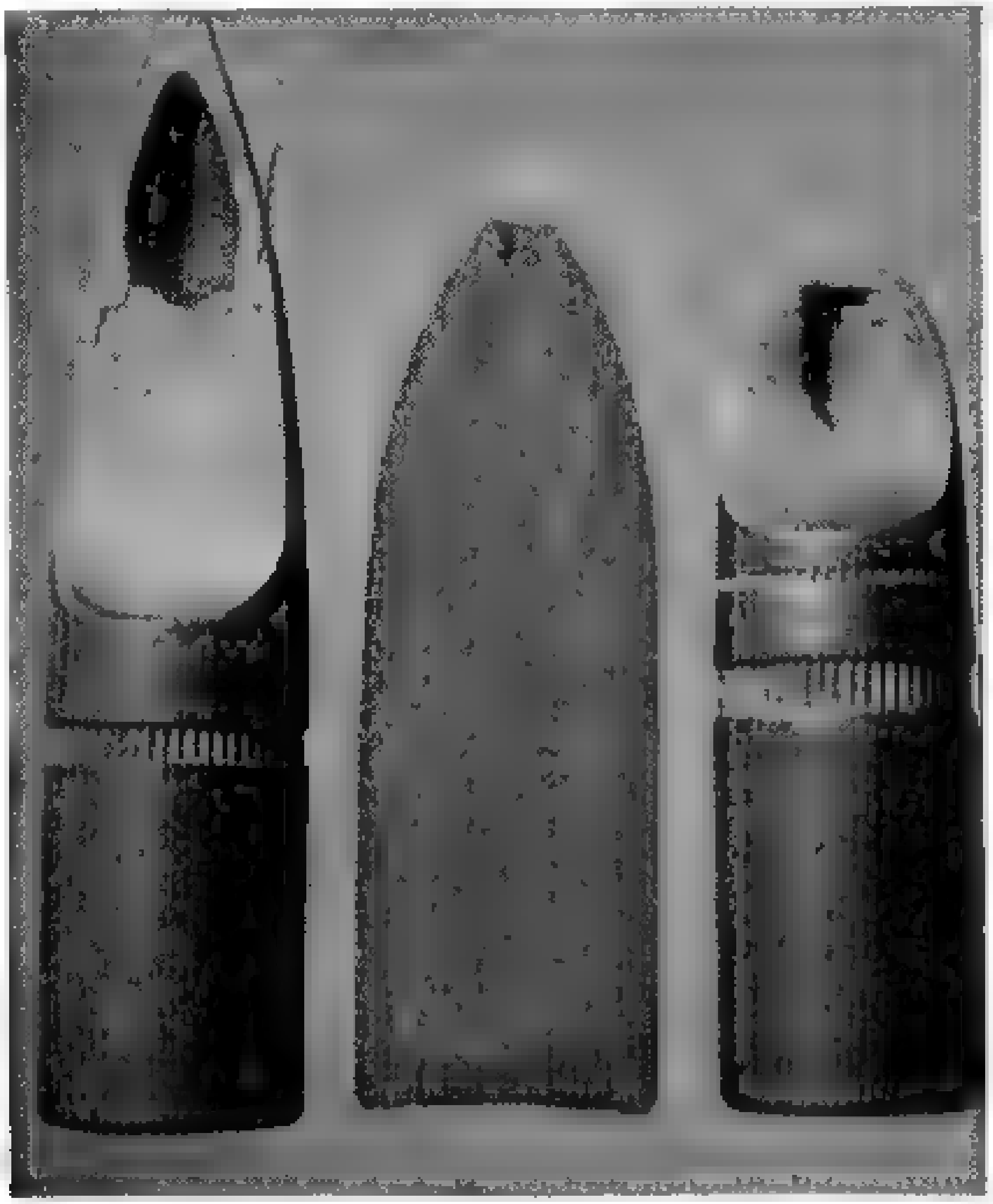
The Peters "Protected-Point" bullet is a jacketed bullet having a core which does not quite fill the jacket proper and is covered by a specially formed cap of copper or gilding metal. In addition, there is a third section or false nose which is crimped under the mouth of the jacket between the jacket edge and inside cap, thus giving a hollow shell of proper contour to match an ordinary Spitzer bullet. On impact, this hollow copper nose mashes flat while the cap over the core is driven down, thus swaging the core to a larger diameter, splitting the jacket and starting expansion.

That it is a complicated proposition to manufacture is evidenced by information submitted by

The RWS "H" jacket bullet after firing. Note complete shattering of nose portion and almost perfect remainder of the base section. An excellent hunting bullet

the Peters factory in 1927. The 180-grain Peters "Protected Point," if carried through from one machine to another in the different operations and manufactured singly, assuming that the machines were all set up to handle it, would take between two and four hours to manufacture complete. This particular bullet receives fifty-one separate and distinct operations before loading, which does not include auxiliary operations such as are controlled by one machine and including the fitting in and knocking out of the bullet or jacket from a die at any particular stage of manufacture. In the above, for instance, each draw is counted as one operation, although one might care to analyze that further and consider a draw *four* operations, the one operation being subdivided into the actual drawing blow, stripping and knocking out—in

other words, each machine movement. All bullets, despite the fact that they are put through with great rapidity by various machines, undergo numerous tests and many operations. Some are annealed, some are left "as is." Some are cannelured when finished, others are left with straight sides. The manufacture of these bullets is by no means



American hunting bullets. Left, the Peters protected point. Center, the Western Tool & Copper Works cavity point. Right, Peters hollow point

the simple task a great many handloaders seem to think.

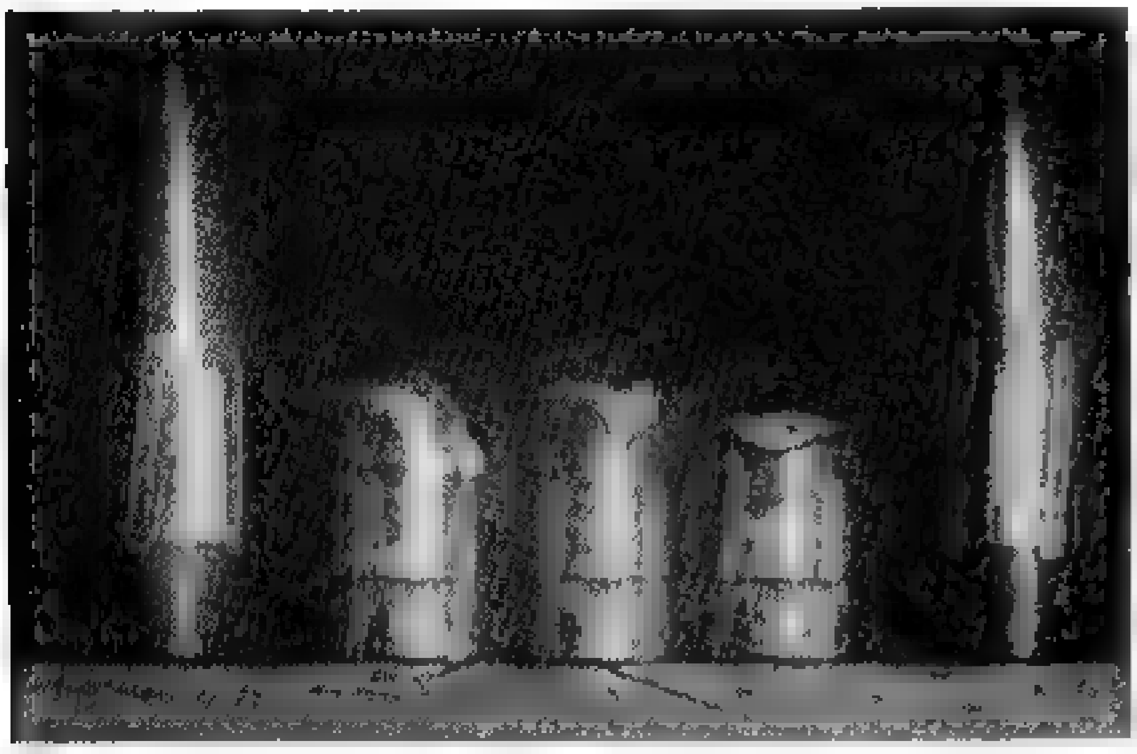
Although gilding metal has been used for bullet jackets for a great many years, it is believed that its real possibilities have been learned only in the past decade or so. The old gilding metal or "copper," as it was generally known, was quite soft. Bullet makers drew their jackets through the routine process, but annealed between the various operations. The net result was an extremely soft metal totally unsuited for the present-day demands of high-speed shooting. With the progress of the science of metallurgy, however, they learned that it was quite practical to eliminate many or all of the various annealing operations. Result: a hard drawn material. If you happen to have any old .22 rimfires at least fifteen years old, shoot one of them and then test the hardness of the copper case by mashing the mouth in the fingers. You will find it comparatively simple. If you try a modern .22 rimfire, you will find that the copper is a great deal stiffer than in times past; it is practically impossible to mash it. Thus have bullet jackets also stiffened up, and if you have on hand any of the old types with extremely soft jackets, use them at low or medium velocities unless you are looking for a bad dose of metal fouling.

For some peculiar reason or other, the makers of copper or gilding-metal jackets in times past insisted on coating these bullets with tin not quite thick enough to be called a "plating" but more or less of a wash. This undoubtedly helped to give rise to the popular notion that bullets have "steel jackets." A year ago a prominent writer and Army officer, who should have known better, insisted that "there is no such thing as a tin-plated bullet, as tin plating has never been used in this country." It's these easily proved misstatements which kill much of the shooter's faith in our so-called "authorities." Throughout this book the author has endeavored to omit as many as possible of his own personal ideas and to deal with facts—facts which in many cases are newly presented but which can be readily verified. Remington, Winchester, Peters, Western—they all used these so-called "tin-plated" bullets, and millions upon millions of them have been manufactured in the United States since the turn of the century. Today, however, they are becoming a rarity.

The tin plating was actually a very thin wash chemically deposited. Why it was put on, no factory official has ever been able to explain to the writer. They just did it. Somebody started it and everyone continued on with it throughout the years. It is quite possible, however, that the original idea was to make ammunition salable over a long period of years. In many small communities a dealer stocks up on ammunition and retains it on his shelves for several years. A shiny copper-plated bullet is far more attractive than a tin-plated bullet when it is new and shiny, but under certain conditions of storage it will tarnish and look "old." Bearing this in mind, it is quite possible that ammunition makers tin-washed or tin-plated their bullets in an effort to keep them looking well over a longer period of time than would otherwise have been possible.

Frankford Arsenal also experimented with tin-plated bullets a number of years ago. At the big Government Arsenal was born the famous FA "tin-can" bullet, samples of which are still in my collection. In 1920 the boys at FA manufactured a cupro-nickel bullet in 170-grain weight which was somewhat undersize and, as I recall it, built it up

to normal size with a heavy tin plating. The plating was done with an electro-chemical process, and the bullets were attractive to behold. They shot well and did much to eliminate metal fouling, but then came the proverbial colored gentleman in the kindling. Cartridges loaded with these "tin-can" bullets started to wreck guns, if the ammunition



Effect on the bullet of shooting a tin-containing powder such as IMR #15½. These jackets are of gilding metal. Notice bright tin plating on the jacket where it contacted the bore, and absence of plating on the base section of boat-tail

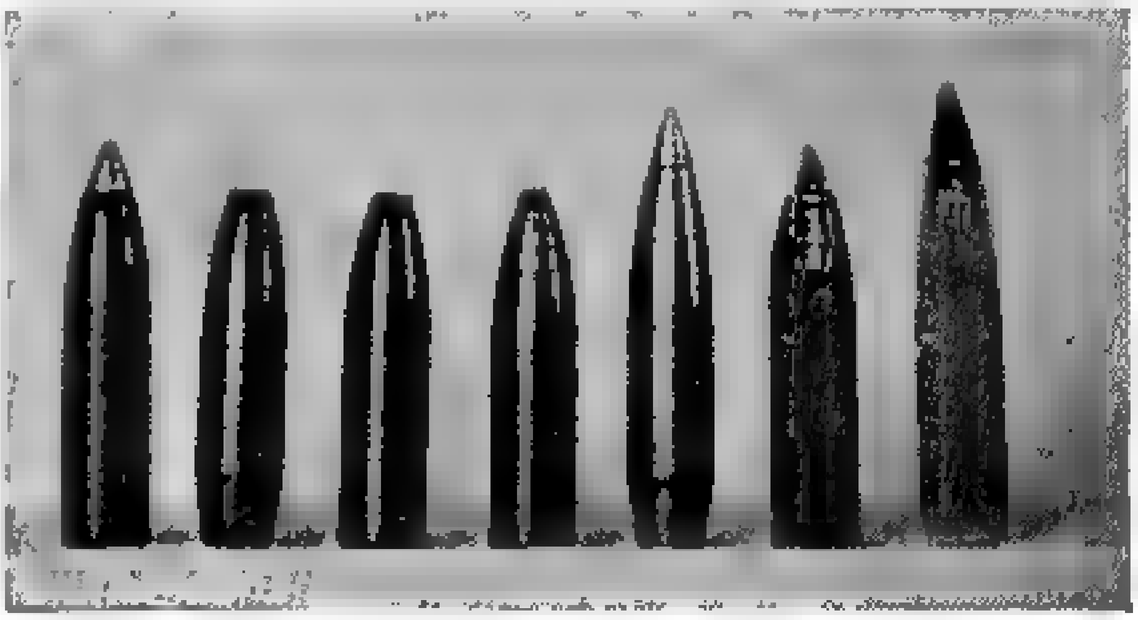
had been in storage anywhere from six months to a year. Examination disclosed the fact that when a bullet was normally seated friction-tight in a cartridge case, its heavy tin plating created a chemical action which practically soldered the bullet to the neck of the case. Pressure, therefore, was enormous. A normal military rifle cartridge in any of the standard calibers should require a pull of from 60 to 90 pounds to draw the bullet from the mouth of the case. A couple of years after loading, I saw a certain .30/06 cartridge run up to 600 pounds in the pulling machine before the bullet let go. Only one was tested because it broke the machine.

It is quite possible that this trouble with tin plating had some effect on our commercial makers, because shortly after that experiment at Frankford, the various companies began to discard the use of tin. It has not completely left the picture, however, and a recently purchased batch of .25 Remington Automatic Rifle cartridges with hollow points, Remington manufacture, had tin-plated bullets. Also a 1935 supply of .38 Super Automatic and .45 ACP cartridges had tin-plated bullets. An easy way to test your bullets to determine whether they have a tin wash or whether the jacket is of cupro-nickel is to rub them briskly against a soft-wood board or a piece of cloth held over a board. The tin plating is so very thin that a spot of it will burnish off quickly, disclosing the copper color of the jacket beneath.

There is no ideal bullet jacket material today. Until recently, Western Lubaloy was superior to any of the so-called "early gilding metals." With present manufactured bullets of all makes, however, the quality has been so greatly improved by advanced formulas and methods of manufacture that the average jacket material will rank closely with this special patented material.

In Europe a very mild steel is widely used as a jacket material. Actual tests, however, indicate that it doesn't grant as long a barrel life as copper or cupro-nickel. This steel is very rarely used naked, and may be plated with either cupro-nickel or copper. This plating is of reasonable thickness; much thicker than the so-called "tin wash" used in America. England uses many steel bullets plated with pure nickel. This is inclined to give more or less patchy fouling. The long-range Match bullets are of steel, plated with the Nobeloy formula, similar to Western Lubaloy. I have shot a great many hundreds of these through my pet Springfield barrels and notice no appreciable wear.

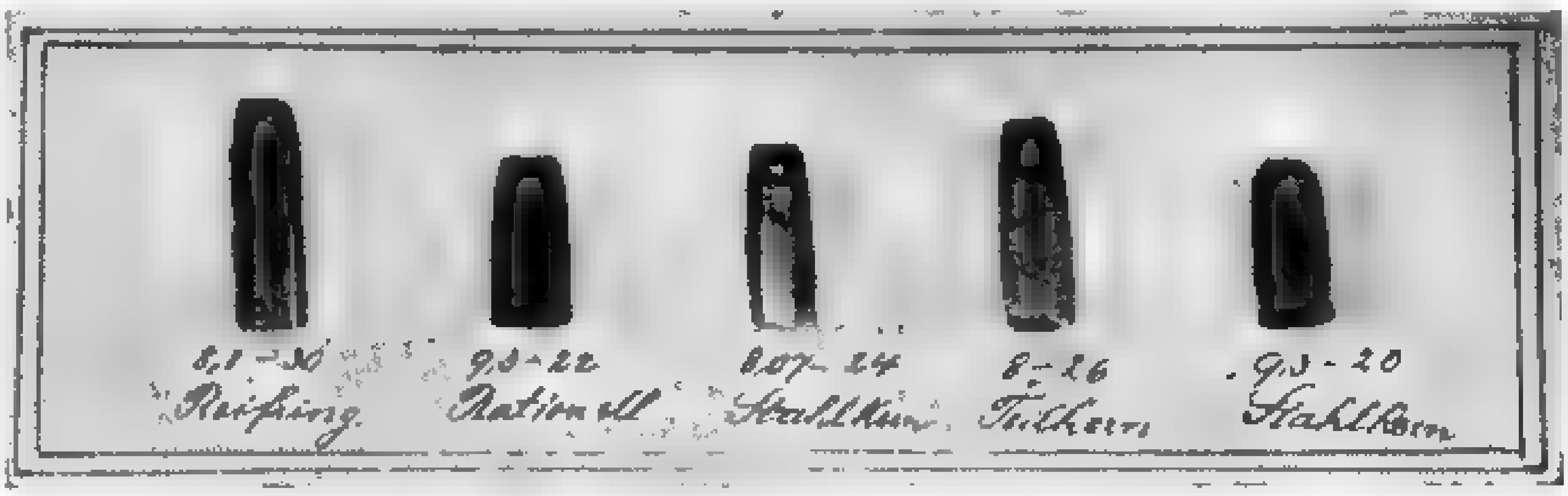
There is another jacket material that has been introduced in recent years in Germany and is widely used in that country, and bullets jacketed with this material are widely sold in America



Some excellent German bullets available in this country for handloaders in both DWM and RWS manufacture. All the above are 7-mm. bullets

through various import agencies. Bearing the imposing title "Trio-Metal," this material is actually a sort of sandwich stock made of three layers of metal. The base, of course, is of steel of a mild, highly refined nature. It is rolled into thin flat sheets and a layer of cupro-nickel foil is placed on either side to form a sandwich. The three sheets are then subjected to tremendous hydraulic pressure, which bonds them into perfect unity. This trio-metal, therefore, appears more or less like a cupro-nickel-plated steel jacket but is far superior

in that it does not have the porous quality natural to any electro-chemical plating process. I have shot these in .30/06 Sporters and several hundreds of them have been shot through my Winchester 54 7 mm., slow and rapid fire. At no time have I found the slightest tendency toward fouling, and the accuracy of certain bullets in both calibers left nothing to be desired. This material, however, is a bit more expensive than ordinary jacket stock, owing to the manufacturing process; but its various advantages are such that Europeans consider hunting loads require reasonably high velocity, great shocking effect, *plus target accuracy.* For ordinary snap shooting at deer, bear, moose and other animals at the customary Eastern hunting ranges of approximately 50 yards, so-called "target accuracy" is not necessary; but the chap who loads for long distances, such as are found in Western and mountain hunting, wants every bit of accuracy he can cram into his particular batch of cartridges. Otherwise, the whole theory back of his handloading will be wasted.



Interesting German hunting bullets. Left: The Reifring. This is a very long exposed soft-point, the jacket covering only the portion contacting the rifling. Around the upper half of the soft lead core is a band of copper to control expansion Next, the Rationell, a bullet jacketed clear to the point, but with a sleeve type of jacket not closed at either end. Next is the Stahlkern, or steel kernel, meaning steel core. A bottle-shaped insert of steel is inserted in the center of the soft-point bullet. This is of course intended for heavy and dangerous game to insure positive penetration and was designed for some of the old-time black powder rifles. Next comes the Teilkern. In this, the core is composed of three pieces of aluminum with a soft lead nose. Two of the pieces of aluminum are slashed off at an angle rather than in the form of perfect discs. This was intended for low-velocity rifles to insure a complete breaking up of the bullet on impact. It was never very accurate, but was extremely popular in Germany for short-range shooting. Extreme right: Another soft-point steel-core bullet for heavy game

the added expense well worth while. The author, however, does not feel that any of the imported bullets are sufficiently superior to American-made products to warrant the expense.

There is one particular thing which this book will not endeavor to do—it will not try to say which bullet is the best for any type of game. Any decision of this nature would merely be controversial; all facts presented could be met by counter-facts of equal brilliance. The handloader, therefore, in preparing himself for hunting, should study carefully the bullets available to fit his particular caliber. Elsewhere in the text will be tabulated the factory diameter of practically all American bullets which the handloader can use with a certain amount of success. Any of the jacketed or lead bullets which fit his particular barrel may be used, but here he should experiment and experiment carefully. He must determine whether he is seeking target accuracy, power, explosive effect, or penetration. One cannot have everything in the same bullet. By the same token, hunting loads cannot be passed off without analysis. Varmint

Cupro-nickel jackets, because of their tendency to foul a barrel more quickly than gilding metal, can be made to perform with the finest and most uniform accuracy if loaded with powder containing a small amount of tin, such as Du Pont #15½ and #17½. No-tin-bearing powders seem to give the finest results with copper or gilding-metal jackets. Within the next few years handloaders will see entirely different jacket materials. The perfect bullet is not yet here. Numerous changes have been made, numerous improvements. Jackets are made much better today than they were ten years ago. Effort is being made to balance them for finer performance and to thin down a jacket at the point on expanding types of bullets. The process is a long slow one and requires as a testing laboratory the Grand American Public. Factories watch closely reports of bullets in certain calibers which either fail to expand properly on game or always expand too quickly, and they often heed warnings thus given.

A quarter of a century ago the handloader was limited in his choice of soft points; today he has

various types. Western produces certain bullets with just a tiny tip or core exposed at the nose. This they call their "short exposed soft point." Other makers use a very long exposed point, some use long exposed soft points with a hollow cavity. Some so-called "round-nose" bullets are actually semi-Spitzer. Other soft points are made in full Spitzer contour. We then have the hollow copper tubes previously described, and many riflemen have used with considerable success the Dominion Cartridge Company (Canada) patented "Pneumatic" bullet.

This "Pneumatic" bullet is somewhat peculiar in design. It appears to be a full jacket, but the nose has a very slight depression in its tip. Beneath this depression, within the core of the bullet itself, is a hollow cavity filled with air. The impact of the bullet creates a sort of pneumatic effect mashing the nose out to a considerable extent and doubling or tripling the caliber of the bullet. The writer has experimented with these quite extensively, and despite the claims of the makers, he has found them far from being reliable. Shooting at various types of penetrable materials, he has found that some will expand while some will cause the core to flow forward within the jacket, closing up the cavity and acting more or less as a full-jacketed bullet. They are quite inclined to ricochet, and in shooting into penetrable material a great many were wasted because the bullet changed its course and came out at the side instead of continuing in a forward direction. A large bear was shot with one of these and killed instantly. Examination of the carcass, however, revealed that the bullet entered, expanded to a certain extent, creating a dangerous wound, struck a far rib, ricocheted off at right angles, and came out through the top of the animal, breaking its back.

German Bullets. In Germany, the Berlin-Karlsruher Industrie-Werke A.G., turning out the famous DWM brand of ammunition, has developed a gilding-metal-jacketed bullet somewhat peculiar in design, which they call "Starkmantelgeschosee" or "Strong Jacket." In this the jacket is exceedingly thick at the base and thin at the nose. Definite experiments with two DWM bullets, both of the same weight, in the 7 mm. were made by the author at Du Pont's Burnside Laboratory during a full week of tests made there in 1934. These "Strong Jacket" bullets, using American powder, showed higher pressures and lower velocities than the ordinary German and American bullets of the same weight. The idea back of this development is to secure a bullet which will expand at the nose but *will not shatter* because of added strength of jacket material, thus retaining a sufficiently large slug to insure great depth of penetration plus an exit hole. In Germany, shooting is very definitely a sport with rules and regulations to be followed. The hunter must abide by these rules, and the prevailing custom is to track the animals. A good blood trail is therefore considered vital, and the hunters demand a bullet which will not only expand and create a serious wound but will also exit from the carcass and create a wound sufficiently large to produce the necessary blood trail should a wounded animal escape after being hit.

The *Rheinisch-Westfalische Sprengstoff Actien-Gesellschaft,* makers of the famous German RWS brand, have developed a somewhat different bullet known as the "H-Jacket." This is somewhat peculiar in form in that the jacket is folded around the waist in the form of an "H." All samples which the writer has seen have the Trio-Metal jackets. We have shot some 500 of these bullets for various velocity and pressure tests, and a great many of them have been used in conducting experimental firings to determine their mushrooming qualities. The makers claim that this hollow copper-tube bullet will shatter its jacket invariably as far back as the waist, thus leaving approximately one-half to two-thirds of the bullet intact to insure penetration. Out of some forty or fifty shots fired into all kinds of material in penetration tests, *not one bullet* was found which did not perform *exactly* as the makers claimed, which proved to be extremely interesting since very few bullets live up to the claims of their makers.

The RWS 7-mm. 173-grain "H" jacket bullet. Notice fold in bullet jacket and perfect condition of recovered bases. Fragments of the nose are also clearly visible

In design, this bullet is perhaps the most unusual in the entire expanding family. The exact method of its manufacture is not known to the writer. However, a dissection of several samples indicates

the probable method. The jacket is first drawn in the form of a straight tube. A half-size core is dropped in and swaged into position. At the top of this short core the jacket quite probably is then heavily cannelured to start a fold, which, when completed, will give a sort of "H" cross-section. Special plugs are then inserted into the front of the jacket, which also support the outside, and the entire unit is compressed, thus forming a very tight although slight fold. This undoubtedly has a somewhat hollow-core plug nose to permit the surplus lead from the short core to flow into it. Another process then bumps this surplus core to completely fill and flow around the fold in the jacket, whereupon the second section of the core is inserted, and swaged into position to pack tightly against the base portion of the core; the bullet swaged to form its taper; and the hollow copper or aluminum nose inserted. Cross-sectioning the bullet clearly indicates this two-piece core and partially explains why the nose portion so readily breaks up into fragments upon impact. It is interesting to note that although this bullet has been on the market since about 1932, patent rights were obtained by Remington early in 1935. The last word from Bridgeport, however, indicates that they do not at the present time contemplate manufacturing this "H-Jacket" bullet. The author, for one, would like to see it, as he thinks it has excellent possibilities in our various big hunting calibers.

Cavity or hollow points have been manufactured in a number of different styles. The Western Cartridge Company turns out its bullets with a series of knurlings behind the point, parallel with the axis, the idea being to aid in the expansion. These bullets are widely used and exceedingly successful. The Western Tool & Copper Works of Oakland, California, produces cavity points with a very tiny hole in the nose and jacketed with gilding metal or very hard drawn copper. These have the tiniest cavities of any bullets offered under the designation of hollow points, and if shot at the velocities for which they are designed they invariably expand and do a good job.

Making metal-jacketed bullets is by no means child's play, and requires extremely accurate dies and equipment. Here is a set of bullet swages designed and manufactured by H. A. Donaldson of Little Falls, New York, for his own use. Unheaded .22 long rifle cartridge cases are used as jackets, as may be seen on the right of the picture. The unswaged core is made of cast lead and when dropped into the jacket is formed by means of an arbor press. With this type of hand equipment, precision bullets can be manufactured, but a good man cannot turn out more than 35 or 40 per hour. Very frequently production drops below that with about 20 per hour. The major difficulty in manufacturing bullets at home is in securing the proper bullet jackets. Manufacturers of small arms ammunition refuse to sell these jackets to handloaders for home manufacture of bullets

Jacketed bullets in light weight and designed for extreme explosive effect on game and varmints must be chosen with more than ordinary care. Any bullet made will ricochet under certain conditions. Some will ricochet under *any* conditions and a varmint bullet should be as near fool-proof as is possible. In varmint shooting the major purpose of handloading is to develop a cartridge that

will kill at the handloader's pet shooting range. The item of meat spoilage is not taken into consideration. The greatest explosive effect and greatest shocking power are desired. In .30/06 caliber the Remington 110-grain Hi Speed is an excellent varmint bullet when the cartridge is loaded to full capacity. If it is loaded down to around 2500 or 2600 it cannot be depended upon to expand, owing to the thickness of the jacket material. Handloaders should bear this in mind.

Soft-point bullets at medium velocities are more certain to expand than the so-called "hollow-points." Many a hollow-point bullet has been shot through game without any expansion whatever if it happened to fail to come in contact with bones. On the other hand, other hollow-points are extremely destructive. Some hollow-points have an egg-shaped cavity in the nose. Others have a cavity which merely penetrates the jacket without mutilating the core. All are reasonably satisfactory, but the handloader should choose with care.

There may be a reason for variation in the price of certain calibers of bullets. For a concrete example there *may* be a reason for the 170-grain .30/30 Winchester soft-point boat-tail bullet costing $10.75 per thousand, the 190-grain .303 Savage soft-point costing $19 per thousand and the .30/06 Springfield bullets in any weight costing $27 per thousand. The author admits that there is probably a reason, but in twenty years of reloading he has failed to learn what that reason is. Most .30/30 bullets at $10.75 are fully as well made as Springfield bullets costing $27. It would seem that the handloader is rather up against it here.

Concerning Prices. Of course Uncle Sam is not a commercial producer of ammunition, yet members of the National Rifle Association can purchase from Frankford Arsenal the standard 173-grain boat-tail bullet at the 1937 price of $5.66 per thousand plus $1.10 packing charge. At the same time he can buy National Match cartridge cases primed for $10.26 plus $.75 packing charge; a total of about $11 per thousand f.o.b. Frankford Arsenal, Philadelphia. If he likes to buy commercial .30/06 cases he pays to the tune of $40.50 for the same thing. In the .30/06 caliber, at least, it would be economical for the handloader to use these cases and bullets even though he prefers a commercial non-corrosive primer. These bullets, of course, are not satisfactory for hunting purposes and should be used solely for target shooting.

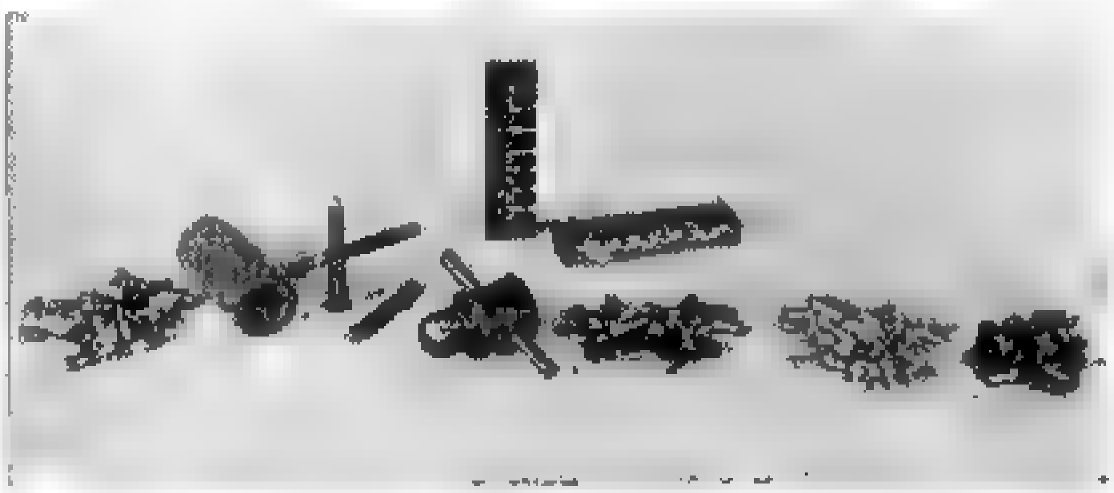
It is well to bear in mind, however, that the commercial manufacturer is up against an entirely different problem in manufacturing and distributing his products. He must pay the initial cost, installation, maintenance, replacement and obsolescence of his very expensive machinery. He must maintain a tremendous manufacturing plant, pay heavy taxes, dividends on capital stock, and salaries of individuals from the factory workers up through inspectors, laboratory executives, sales and shipping departments, and executive personnel. Frankford Arsenal has none of this to worry about. Its sales of ammunition and components are so small as to be almost negligible. It may experiment with any new process, development, or problem having little practical value, and none of this great expense must be met by reasonable sales profits. All the major expense is borne by the United States taxpayer.

The marvel of the entire Director of Civilian Marksmanship's price list to N.R.A. members is that astounding sub-price list on "packing charges." Despite the fact that the taxpayer is already footing this bill once, Ordnance depots demand a packing charge which far overshadows the gravest affronts of any commercial manufacturer. There is absolutely no logical reason why it should cost a purchaser $1.35 to pack a standard military rifle. The commercial maker of rifles and shotguns could never market his product if it cost any such sum to "pack" a single gun. Taxpayers' time covers the actual labor. Materials for a rifle shipping box do not cost over 25 cents at the most. Why, therefore, the $1.35 charge? Why a packing charge of $1.35 for a *barrel* which does not cost more than 10 cents for packing materials? Also why the price list memo "for each additional rifle, barrel, stock or barrel and receiver assembly in the same order, $1.00 additional"?

Another interesting quotation from the Ordnance price list in effect at this writing is this: "A standard packing and handling charge of 10 per cent of the list price will be made . . . with a minimum charge of 25 cents for any one order." Where is the great favor to shooters? Suppose you want a pair of trigger-guard screws for your Springfield. It costs 8 cents for the screws plus 25 cents for packing, plus 8 cents postage, plus 7 cents money-order fee, plus 5 cents "tax," plus 3 cents more postage to Springfield Armory, a total cost of 56 cents. If you want a pair of guard screws for your Winchester 54, send Winchester 20 cents in stamps, and put a 3-cent stamp on your envelope. No packing charge, no return postage. The screws will come through at the 1½-cent rate in a cloth bag identically the same as the Springfield Armory shipping bag.

Suppose you send in a rifle to be repaired or rebarreled. Springfield Armory charges you 50 cents

packing charge if you send it a case that can be used to return the gun! And if you desire to purchase 2000 bullets from Frankford Arsenal, you are assessed a packing charge of $1.80. If you want 2000 empty cases for your reloading, you pay $1.25 for packing. Packing on 5000 primers totals 70 cents. Even though you order through for a single shipment, 2000 cases, 2000 bullets and 5000 primers, you pay the total of the packing charges—$3.75. Any commercial firm which set itself up in the packing business at prices such as Uncle Sam charges, would reap a fortune in short order—except for the fact that no one—not even the Ordnance Department—would patronize such a firm.



Home equipment for the manufacture of Hornet bullets from .22 short fired cartridge cases. This bullet swage was manufactured some years ago but did not prove successful, as it is extremely slow in operation, and Hornet bullets can be purchased much more cheaply than they can be manufactured. The cores are cast in the special mould as illustrated, and are inserted in the fired cartridge cases after the rim has been removed by forcing through a die. The bullets shoot well but are by no means perfect, as the various wrinkles cannot be removed even with extreme pressure

In commercial practice, the most expensive part of business is sales expense. For every retail dollar, the retail dealer, jobber, and distributor claim about fifty cents. The manufacturer must double his bare manufacturing expense to cover the normal business expense of sales, advertising, business management, experimental work, and the rest of the necessary plant overhead, none of which can be eliminated. And on top of this he must make a small profit. Yet the manufacturer of a firearm or the ammunition therefor *makes a much smaller profit than any individual or firm handling it!* There may be a price schedule on ammunition components which is a trifle unbalanced in different calibers, but at least the commercial manufacturer is honest in that he doesn't camouflage his prices with ridiculous "packing charges" such as have been racketeered by the United States Ordnance Department.

Altered Bullets. A great many handloaders experiment with operating on metal-jacketed bullets to make them expand and thus acquire cheap hunting loads. This experiment is one which sooner or later the handloading bug is sure to play with, and just as surely will he suspend the experiment as not worth the time and effort. One method of altering bullets is to file or grind the nose off a full-metal-jacket Spitzer bullet until the core is exposed, whereupon some experimenters like to continue the work by running a drill into this exposed lead for a short distance. Some of these bullets, of course, will be unreliable.

More than fifteen years ago—after the close of the World War—I had a friend down in Del Rio, Texas, who used quite successfully ordinary war-issue ammunition which he doctored without unloading. He used an ordinary jeweler's hacksaw with very fine blades. Three slash marks were sawn diagonally around and at the extreme point of the bullet, said slash marks extending back approximately .5 inch on the ogive. They were slashed, of course, in the direction of the rotation of the bullet, and upon impact the nose was twisted off and the bullet expanded. I shot quite a few of these, but found that the process was rather tough on the delicate saw blades, and after breaking two or three dozen of them I decided it was not worth the time and effort—so did the chap who told us of the idea.

In Europe the so-called "split" jacket is widely used, although no American maker manufactures this. The split jacket is essentially a full metal-patch or soft-point bullet, the jacket of which has been split with fine saws into little slits approximately ¼ inch long and running longitudinally on the jacket. The mouth of the jacket remains closed, but the initial upset of the bullet splits it along these four to six saw slits, thus creating a tremendously effective bullet which is often misnamed the "dumdum." This famous dumdum bullet is perhaps one of the most misunderstood and yet most glibly talked of developments in the entire shooting field. Very few shooters know what the dumdum really is.

The dumdum was a full-jacketed round-nose 215-grain bullet which had the nose filed off to expose the point. Early British books indicate that the original dumdum was a .303 bullet developed by the British Government for military purposes and first manufactured at the famous Dumdum Arsenal in Bengal, British India, some five miles northeast of Calcutta. This arsenal is essentially a Government factory where much of the ammunition for various Colonial possessions of Great Britain is manufactured. Another expanding military bullet was officially known as the ".303 British Mark IV." It was a 215-grain round-nose soft-

point bullet which in addition carried the so-called "split jacket." This development appeared some time during the 1890's, but with the dumdum was outlawed by the International Peace Conference of 1899. The use of these bullets by the British Government was restricted to native uprisings where fanatical British subjects took a great deal of killing. The Mark IV bullets, often misnamed "dumdums," did the job well. The entire bullet practically disintegrated, the soft point plus the split jacket creating wounds that stopped natives quickly and effectively.

Since that time the so-called "expanding" bullets, according to our politicians, have not been used for military purposes; but both sides during the World War complained that expanding bullets were being used in violation of international agreements. Without a shadow of doubt this was true, despite the denials from our high officials. The author has seen numerous specimens of expanding bullets camouflaged under various names such as "incendiary," "armor-piercing," and that type of thing. In his possession is a clip of 8-mm. Austrian Mannlichers, with head markings indicating 1917 manufacture, which were picked up on a battlefield beside a dead Austrian soldier. These cartridges were loaded with a soft-point split-jacket assembly which would be equally destructive on man or beast. International agreements are made to be broken. Despite the fact that we have international laws prohibiting this and that, these laws are broken in each and every war. It was the custom of one nation in the World War to search all prisoners, and if any were found possessing expanding bullets they were immediately executed. Soldiers, however, merely shoot ammunition which is issued to them. . . .

Definite tests have been made with various shapes of bullets, and it has been found from actual analysis of wartime casualties that the Spitzer is by no means the humane bullet which our politicians like to claim. In my capacity as a firearms editor I constantly receive reports from chaps who do their big game hunting, particularly on deer, with ordinary "as issued" full-metal-jacket military cartridges. The reports of the wounds are often quite interesting. Sometimes the bullet penetrates cleanly, making a very minor wound in accordance with the claims of those gentlemen who make our "humane" war laws. At other times it will dive, change direction, tumble and otherwise create general havoc within a body. Any Army surgeon who served in the field during the World War will testify to the truth of the above statement. Rarely is the path of the Spitzer bullet as straight as that of the old-fashioned round nose. The United States Government has also experimented with bullets in various ways—for instance, on animals both alive and dead, and on cadavers.

There are still floating around in these United States tremendous quantities of wartime-loaded .303 British rifle cartridges bearing the designation "Mark VII." This cartridge is loaded with a 174-grain Spitzer bullet, and it will surprise a great many readers to know that the construction of this bullet strays far from the accepted method of lead-core-metal-jacketed types. In truth, it is a particular type of *hunting* bullet designed by the late Leslie B. Taylor of the firm of Westley Richards of Birmingham and known in hunting cartridges as the "Velopex" bullet.

Of all military bullets in use today, this Velopex is by far the most wicked and should be outlawed. It is almost as effective on game as an expanding type of bullet although it does *not* expand. It is thoroughly unbalanced and upon impact tumbles and very frequently breaks up. This is due to its design, in which a *two-piece core* is used.

The original Velopex bullet consisted of a full metal jacket, in the tip portion of whose core some light substance was inserted. Various materials were used in the early Westley Richards bullets, among them being softwood, hardwood, fiber, etc. It was found that such a bullet was extremely effective for use on African game in which more than normal penetration was necessary. At the same time the bullet broke up to a certain extent, the shattered fragments creating serious interior wounds and the remaining lead core and jacket just holding together sufficiently to insure extreme penetration. In cases where the bullet did not break up, the tipping or tumbling effect due to lack of balance made it smash its way through the game sideways. This was often noticed in enemy soldiers shot with the British Service cartridge during the World War.

The British Small Arms Manual—1929 edition—says in discussing the present Service bullet: "Comparing, for example, the Great War with the South African campaign, it is quite clear that the wounding power of the pointed bullet is greater than that of the round-nose Mark II bullet. The through-and-through wound was rare, while explosive exits were common, and at greater ranges. The effects on bone also were more severe, the shattering being foretold by Fessler in 1905 as the result of his experiments with the pointed bullet."

The British manual goes on to discuss these bullets for use against human beings, particularly in regard to stepping down from the old .45 caliber Martini lead bullet to the small .303-caliber roundnose and "diminished" effect in creating the necessary stopping power.

"What was lacking in the matter of deformation (increased diameter on striking) could be made up for by specially made 'expanding' bullets, and these were used against big game and also against savages and fanatics," the book states, "but in civilized warfare these bullets are expressly ruled out, and it was not until the introduction of the pointed bullet that a more satisfactory stopping power was attained.

Winchester and Western Magnum bullets are excellent to behold. These five bullets represent the latest additions to the H. & H. Magnum series. Left to right: the .300 Magnum 180-grain Boat-Tail Match (note absence of cannelure); the 220-grain Boat-Tail short exposed soft-point; the three bullets available for the .375 Magnum in standard loadings—235, 270, and 300-grain. The lighter weight is a hollow-point, the others soft-point

"It is estimated that over 90% of deaths on the battlefield are due to bleeding. When these so-called 'vital' parts are wounded, the make or velocity of the bullet is a matter of indifference. . . . Gunshot wounds are of the punctured variety of wounds. That is to say, they are inflicted by missiles which pass deeply and into and through the body, carrying with them germs of infection which are thus deeply implanted in the body. The infection which arises from these germs is the chief cause of mortality and invalidity after gunshot injury. The pointed bullet, having a large area which is untouched, and therefore not scraped clean by the rifling of the barrel, is a more septic bullet than the Mark II bullet. . . .

"It has already been pointed out . . . that the round-nose bullet when fully covered with a cupro-nickel jacket . . . cannot expand on normal impact. The only way of obtaining increase of area on impact was by the method of the expanding bullet, a device which uncovered the lead at the tip and allowed it unfettered action on impact. This, however, was forbidden by international agreements. Increase in area on impact could, however, be attained by making a bullet unsteady so that it tilted on impact and moved sideways through the tissues.

"A bullet of very small bore, like the Japanese .256-caliber bullet, was reported on by Macpherson in the Russo-Japanese War as being very unstable on impact, so that mere diminution of caliber without loss of length seems to make for unsteadiness in a bullet. But according to some authorities the pointed bullet presents the same unsteady character because by its structure the center of gravity is thrown so far back. Unless the point is accurately in the line of the trajectory it immediately on impact becomes under the influence of a couple tending to make it turn upon its short axis. A further lightening of the tip by the substitution of a lighter metal such as aluminum for part of the lead core would enhance this turning effect. . . . Observation of wounds of exit confirms the fact that the pointed bullet does turn in the tissues. Moreover, the increased wounding power of this bullet on soft parts as compared with the neat cylindrical track of the Mark II bullet seems to show that some enhancing factor is present. . . ."

Thus do the British brag of their unbalanced bullet as more humane. As a matter of fact, war is never humane, and while this book has nothing to do with the military aspect of rifle cartridges, it does deal with the hunter. Some riflemen seem to feel that they should shoot their game with the least possible damage to tissue. Others are willing to waste a few pounds of meat in an effort to make clean kills. The American sportsman has different ideas of just what sportsmanship is. If he goes varmint hunting, he feels bad if he blows the innards out of a woodchuck and the animal manages to crawl back into its hole, even though it will die there within a minute. The American insists on a quick, clean, instantaneous kill. All this in spite of the fact that he doesn't even intend to salvage any part of said woodchuck.

The only time shocking power interests a Britisher is when he is out lion, tiger, or elephant hunting in the jungles of British East Africa. Here he insists upon a quick, clean kill for the simple reason that he shoots this dangerous game at short ranges—often as close as 20 or 25 feet—and a wounded lion or tiger, to say nothing of a charging

elephant, is an extremely bad neighbor. The British sportsman therefore demands an assortment of rifle bullets to meet his particular needs, and if he goes hunting in Africa he doesn't mind using a big-bore heavy-weight blunderbus shooting a half-pound or so of metal-jacketed bullet which not only kills the game quickly but which knocks him down and jumps on him. That is part of the sport of shooting, and as an African hunter once told the author on his return from a sojourn in the jungles:

"You have other things on your mind besides worrying about recoil when a quarter-ton of charging lion is only fifteen feet away!"

In Germany many interesting hunting bullets have been developed, varying somewhat from the products of our American manufacturers. One of these developments, now obsolete, is the *Reifring.* This is one of the early bullets designed to meet higher than normal velocities from some of the rifles designed for smokeless powders to replace the old black-powder cartridges. It had what one might term an "extra-long exposed soft point." A sample in the author's hands is of 8.1 mm. caliber (about .32) and 30 mm. long (approximately 1¼ inches). It has an uncoated mild steel jacket about 16 mm. long and shows a bearing on the barrel of 12 mm. The forward portion is necked down slightly and very heavily crimped into the lead core, which continues to form a very long exposed soft point. A quarter-inch from the nose, however, is a sixteenth-inch band of copper, the ring being swaged into the soft point in the form of a belt to control the expansion and prevent its too easy upset. (This bullet was in use twenty years ago—before Peters "invented" the belted bullet to control expansion.)

Another bullet in 9.3-mm. caliber is known as the *Rationell.* This has a very short copper jacket or ring about ⅜ inch long and crimped into the core. As in the *Reifring,* the base of this jacket is open, and it actually amounts to nothing more than a sleeve of hard metal, thus permitting of higher velocities than would be possible with ordinary pure lead. This, too, is now obsolete.

A third interesting type is the 8.07-mm. *Stahlkern,* which was also made in many other calibers. *"Stahlkern"* is the German word for "steel kernel" or "steel core." This has a mild steel jacket and is of soft-point construction. In its interior, however, is a very hard "armor-piercing" steel core approximately $^{11}/_{16}$ of an inch long and $^{5}/_{16}$ in diameter. This steel core is bottle-necked at the forward end and flat on the nose, the bottle neck merely serving to permit the lead core to pack around it and hold it firmly in position. The bullet, until it is cross-sectioned, appears to be a normal soft-nose and is designed to give not only expansion and shattering but tremendous penetration, since the hard steel core will tumble along much the same lines as the armor piercer. With modern high-velocity ammunition and recent bullet developments in Germany, this number is fast falling into the discard. It is made, however, in many calibers and is widely used in African hunting.

Still another development is the 8-mm. *Teilkern,* unique among the so-called "shattering" bullets. This has a mild steel jacket, but the core is composed of four pieces of aluminum which have been slashed off on an angle rather than squared in section. They fit together nicely and are topped by a soft point. This bullet was intended for operation at velocities in the vicinity of 2000 f.s. where it was imperative that the bullet should completely shatter. It is rapidly falling into disuse and is now employed only by riflemen whose arms are equipped with non-adjustable sights that were originally sighted in for this particular bullet. The author has never fired any of them, but examination of their construction clearly indicates that even a low-velocity impact would cause the soft-point short core (only ¼ inch long) to expand, thus splitting open the mild steel jacket and releasing the four irregular sections of aluminum. If pushed up to a reasonably high velocity, it should be a tremendously explosive bullet. All these types are still manufactured by *Rheinisch-Westfälische Sprengstoff Actien-Gesellschaft,* who advise that they are not as accurate as the modern types, adding that of the entire series the *Tielkern* multiple core is the least accurate. We can readily believe this.

During the next few years there will be several new developments in bullets available to American handloaders. Progress in this direction is far from complete, and our ammunition factories are constantly experimenting with newer and better designs.

Handgun Bullets. Metal-jacketed bullets for handguns should be given proper consideration, particularly the expanding types available on the market for reloaders. This does not, of course, mean the so-called "metal-point" bullets common in various revolver calibers. The metal-point is a bullet of lead alloy having a metal jacket *over the point,* chiefly to secure greater penetration. This bullet, in England, is known as the "solid capped" as distinguished from the "hollow

capped." The hollow type appears to have been originated by the late Leslie Taylor of Westley Richards in 1899, while the solid cap comes from the early Swiss previously described. They enable a bullet to have a lead portion bearing on the rifling, but a hard point similar to a full jacket.

Most automatic pistol cartridges use metal-jacketed bullets, either of the full-jacket varieties or with soft points, hollow points or hollow soft points. Gradually these various types are being discontinued by our arms makers, who have long been convinced that metal-jacketed bullets when fired from handguns fail to expand. Gradually, as a result, the soft-point types are being abandoned. For some years they have been discontinued in .25 ACP, .32 ACP and .380 ACP. Hollow points are little better—they cannot be relied on.

Why won't these bullets perform? The answer resolves itself into a manufacturing problem. The handloader who has cross-sectioned a jacketed hollow point finds that his sectioned bullet shows a thicker jacket at the point, and particularly around the cavity opening, than at any other portion of the bullet.

According to the laws of performance, this portion of a bullet should have the *thinnest* part of the jacket. Why make it thick? Again manufacturing practice as against necessity for proper results. Full metal-jacketed bullets have their jackets punched out with the base open and nose closed. The core of lead or a lead alloy is then inserted from the base, and the entire assembly swaged into shape with the base of the jacket turned over slightly to crimp the core permanently into position.

Soft-point and hollow-point bullets are generally built with the jackets formed "wrong end to," as it were, the base being closed and the core inserted from the front. The assembly is then swaged into shape, the swaging process choking the mouth of the jacket down to the diameter of the cavity, thus making the metal thicker, much as one gathers up the mouth of a well-filled paper bag. The only way to overcome this thickening of the jacket where it isn't wanted would be to thin down or "feather" the jacket walls before the insertion of the core. Again manufacturing prevents, as this would be costly and would mean a tremendous number of defective jackets and completed bullets to be weeded out by inspectors. Furthermore, the feather-thin jacket walls would wrinkle and fold in the swaging process.

The single exceptions to this form of hollow-point construction coming to the attention of the writer lie in the high-power rifle bullets of the Western Tool & Copper Works of Oakland, California, and a commercial lot of U. S. Cartridge Company .38 ACP hollow points purchased in 1934 by the author. In the former class of bullets, called by their makers "cavity point" instead of the more common "hollow point," the jackets are formed of *tubing* in both the full-jacket and cavity-point construction. After the insertion of the core, the jacket is folded under and swedged, both at the base and nose. The result is that the bullets made by this firm have fully protected bases, regardless of nose construction, and one can determine their method of construction only by careful examination of the base where a tiny irregular lead spot, a pinpoint of the core, extrudes. By heating a bullet and melting out the core, the construction may be verified. On their "full jacket" types, the jacket is brought to the suitable contour and sealed merely by tightly swaging. Cavity points are full jackets, made in this manner, but usually show signs of their noses being drilled by machine to form a small conical cavity extending through the jacket, but rarely into the core. They expand because they are designed for rifle use at high velocities and high rotational speeds and against heavy game.

The U. S. Cartridge Company sample referred to was made at the factory of Winchester (all ammunition manufactured by this firm since about 1919 has been made in a department of the New Haven plant of Winchester, after United States closed its enormous wartime plant at Lowell, Mass.) but differs from any other Winchester bullets we have examined. It is quite possible that this was an experimental batch. Experiments at factories are frequently conducted in the laboratory, and a production order is issued to try some results of a successful experiment in regular methods of manufacture. The new process is tested by the laboratory and may or may not be adopted. Even with samples *not* adopted, if they are reasonable in performance, it is not uncommon for a factory to dispose of the surplus by dumping it "on the trade" in regular boxes until the lot is consumed. This batch of USC bullets was discovered when samples were torn down for analysis preparatory to a velocity and pressure test for the writer's private information. The bullets were found to have been made like ordinary full metal-jacketed bullets, but after the final swaging the cavity was formed (apparently) by holding the bullet in a jig or die and running a flat-nosed punch into the nose, thus perforating the jacket and forcing a cavity into the

bullet nose. The round disc of gilding metal punched from the jacket was found imbedded in the lead core at the bottom of the cavity. Once noticed, the copper disc could readily be seen by looking into the cavities on other bullets. Practically the same effect could be achieved by drilling a cavity in the nose of a standard full jacket, and one thus can see that it is possible that the idea was incorporated in an experimental batch of bullets to determine the practicability of an idea widely used by "kitchen-mechanic" riflemen for many years.

XII

SEATING OF BULLETS

BULLET seating, although it may seem to be an extremely simple and ordinary proposition, is one of the most delicate in the entire field of handloading operations. The seating of bullets involves a great many important features which the average handloading literature completely ignores. If a handloader overlooks the fundamentals and niceties involved in proper seating of his bullets, the net result will be mediocre or even very poor ammunition.

In loading rifle ammunition it is generally acknowledged by experts and technicians, both in this country and abroad, that the bullet should seat as far into the rifling as is possible. This will reduce its natural tendency to jump from the mouth of the shell to the leade, thus deforming itself through improper upset before it actually gets under way. The average target shooter who uses a .22 single-shot pistol will notice that the bullet seats well into the lands; and if an unfired cartridge is extracted from the chamber, these land marks will be clearly engraved on the bullet. With large-caliber lead-alloy rifle bullets or with metal jackets, this seating into the lands is not practical. Accordingly, the handloader who desires the finest of target accuracy, seats his bullets as far out of the case as he safely may, so that it contacts the lands upon closing the bolt.

If the cartridge is intended for magazine loading, another problem arises. One may find that in his particular gun, should the bullet be seated out of the shell so as to touch the lands, it will be too long to function through the magazine. Therefore he is limited in this overall length. All ammunition intended to be used in magazine loading should be loaded as closely as possible to the standard factory overall length. It is impossible for anyone to list the data as to suitable overall length of any cartridge if an attempt is made to approach the maximum. This is because of individual variation in guns caused through wear, factory variation, or difference in throating.

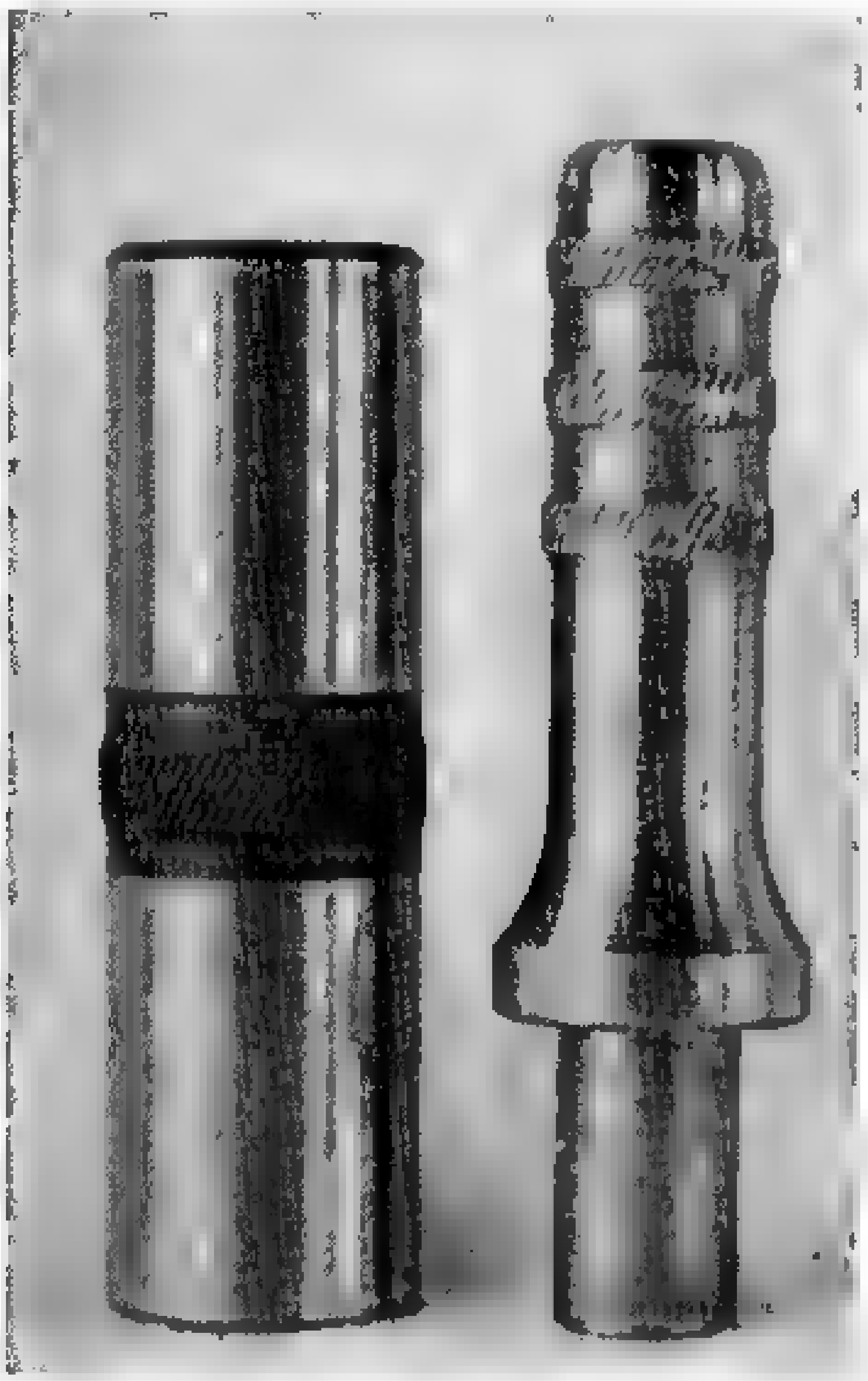
The Springfield rifle which has seen two thousand loads may take a cartridge of overall length approximately 1/10 inch longer than that particular barrel required when it was new. Wear on the leade, or erosion as it may be called, is responsible for this. This does not necessarily mean that the barrel is worn to any great extent. The leade is more or less tapered to accommodate the natural contour of the bullet, and a few thousandths wear will make a great deal of difference, particularly since the wear is on an angle, thus permitting the bullet to seat much deeper into the barrel.

There are two definite ways of checking the leade of your rifle with the particular bullet you desire to use. A resized but unprimed cartridge case should be used and a bullet lightly seated in the mouth of the shell. This should be tried in a gun and an attempt made to close the breech very gently. The dummy cartridge should be removed at frequent intervals and the bullet seated a little deeper into the case each time, trying it in the gun between setups. When you can just close the breech mechanism you can assume that your bullet comes into contact with the leade of the barrel.

If you desire to use a particular lot of cartridges —standard .30/06 loads, for instance—in your pet Springfield, and desire to learn how much the bullet has to jump before striking the leade, the following method is extremely useful. First insert a loaded cartridge into the chamber of the gun and close the breech. Then be positive that the safety is locked into "safe" position and gently insert your cleaning rod from the muzzle of the gun, lowering it slowly until it touches the nose of the bullet. With a pencil, mark on the rod the exact length of the muzzle of the gun. Remove the rod, taking care not to disturb the pencil mark, withdraw the cartridge, and insert an *unfired bullet* of this identical style and shape from the breech. Drop the bullet into the chamber of the gun, secure the breech, and by means of a pencil or softwood block, push the bullet point on into the leade of the gun until it is in solid contact with the rifling. Hold it in that position and put your cleaning rod back. *Be certain that firing pin is removed for safety.*

Meanwhile you must guide the bullet into place in the rifling, making certain that it has not tipped or otherwise slipped off center. Scribe an additional pencil mark on your cleaning rod, and the distance between these two marks will clearly indicate the amount of jump required of that bullet

before it hits the rifling. This is one of the easiest and most practical methods of testing, and the pencil marks can be wiped off the cleaning rod with a swipe of the thumb after they have served this purpose. A great many shooters do not believe in the practical value of dummy cartridges, but the author has found them to be useful in a great many ways. If you make yourself a set of dummy cartridges with regular bullets seated into a resized but unprimed shell, you can prepare a full set to cover all bullets you may use. If some of them have a greater overall length than your magazine will handle, you can so mark them.

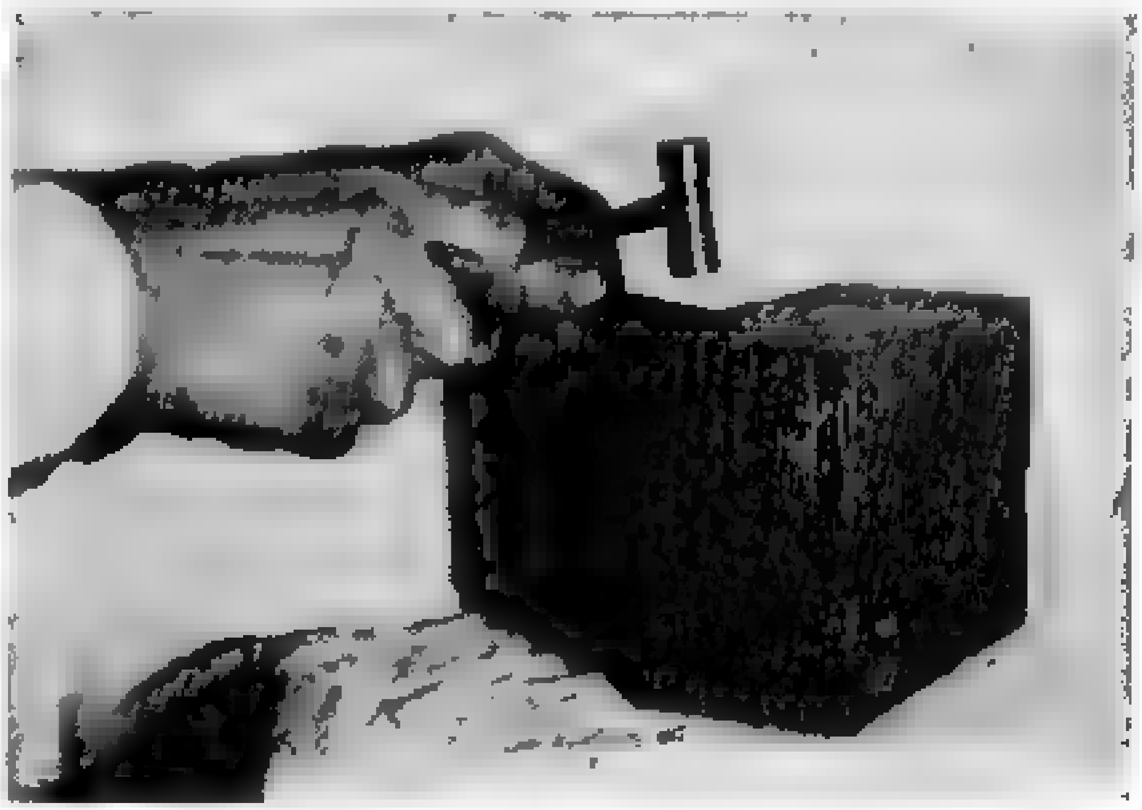


A straight-line precision bullet seater for the .30/06 manufactured by L. E. Wilson of Cashmere, Washington. The body of the tool is chambered to fit the cartridge tightly. The plunger is shaped to fit the bullet

An ordinary scratch awl or scriber, if it is drawn to a needle-sharp point by means of occasional stoning, can be used to write upon any cartridge case, engraving or scratching figures, words or symbols. A glass-marking pencil may also be used. The system is extremely useful in assembling duplicate loads at any time, as you will find it much easier to set up your loading tools without wasting any cartridges. To the handloader there is no such thing as a standard overall length. As previously stated, he should fit his ammunition to his chamber and barrel. If he uses assorted cast and gas-check bullets, he will acquire an unusually wide collection of overall lengths. If he has available suitable micrometer calipers, the setting up of a system of records should be undertaken so that he can duplicate loads whenever desirable.

There is another very definite reason for adhering to recommended bullet-seating depths or overall lengths. A great many powders require a certain amount of air space within the cartridge case for efficient burning. If a load is recommended by a powder maker and he gives either the overall length with a particular bullet or the seating depth with that same bullet, he has arrived at his figures through actual practice. There is nothing theoretical about this thing. He has found the best combination to secure his results.

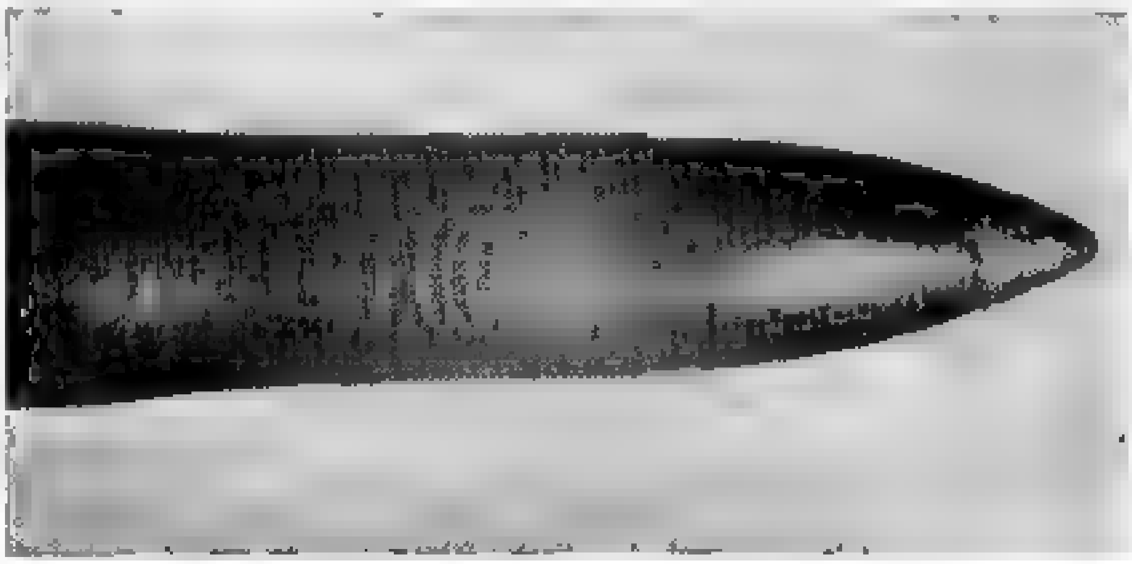
What will happen if his figures are varied? If a bullet is seated deeper into the shell than the recommended standard, the result is a greatly increased pressure and slightly increased velocity. On occasion the pressure may climb dangerously. If the bullet is seated further out of the shell than normally recommended, there will be a slight loss in velocity with a variable loss in pressure, depending entirely upon the load in question. In experimenting with the .357 Smith & Wesson MAGNUM cartridge a few years ago, the author in developing loads found that a certain combination gave a



It is often desired to extract a seated bullet. If no bullet puller is available, metal-cased bullets can be extracted quite readily by the above method. Lay the neck of the cartridge case over some solid metal support. The above block of lead works nicely, but any hard material will serve. With a light hammer tap the neck, rotating the case slowly and gently as you tap. In a moment the continued tapping will expand the brass so that the bullet can be picked out with the fingers. This process does not injure metal-cased bullets, and the powder charge may be removed, the case resized, and the entire assembly reloaded by properly reseating the bullet

velocity of 1480 f.s. with a pressure of 31,000 pounds. He seated the bullet .06 inch further out of the shell and with the same powder charge noted a velocity loss of about 10 f.s. and a pressure loss of nearly 3000 pounds.

It is well to know that rifles vary tremendously and bullets even more. No two factory bullets of a given weight or caliber, if made by different makers, will have the same contour; and this in itself will cause a variation in fitting into the barrel. The handloader who uses assorted factory bullets of various "calibers" but of proper size to fit his barrel, will note a tremendous variation and may find that certain bullets are better adapted to his rifle than others. He can make a note of these facts and govern himself accordingly.



Always make sure that your bullet is properly started before you attempt to force it home. The above example of shaving is typical of carelessly seated bullets. It means not only a cartridge case, but a bullet destroyed. It would not be wise to fire such a cartridge even though one could force it into the chamber

In loading for handguns, one strikes the problem of proper combustion. If a bullet is seated too far out of the case, it is inclined to hammer loose from the recoil. The overall length, of course, is governed by the length of the cylinder, but since it must jump through the cylinder throat in order to hit the leade of the barrel, there is no such thing as seating the bullet directly into the rifling. The closest approach to this is in the Russian Nagent revolver, in which the .30-caliber bottle-neck cartridge has the bullet seated below the mouth of the shell neck. When the trigger is pulled, this neck, which projects over the face of the cylinder, slips into the throat of the rifling, thus eliminating the escape of gas between the barrel and cylinder and starting the bullet with a minimum of jump. Despite the fact that Russia has used this for many long years, it has never proved practical and has not been adopted by other nations.

The easiest bullet to seat in a cartridge case is the metal-jacketed Boat-Tail. This bullet is actually more or less of a self-starter and can in many cases be merely dropped into the mouth of the case before the seating plunger is forced down. The hardest bullet to seat is the true square-base cast form. Gas checks ordinarily seat very readily, as they have a rounded bottom to fit into the mouth of the case.

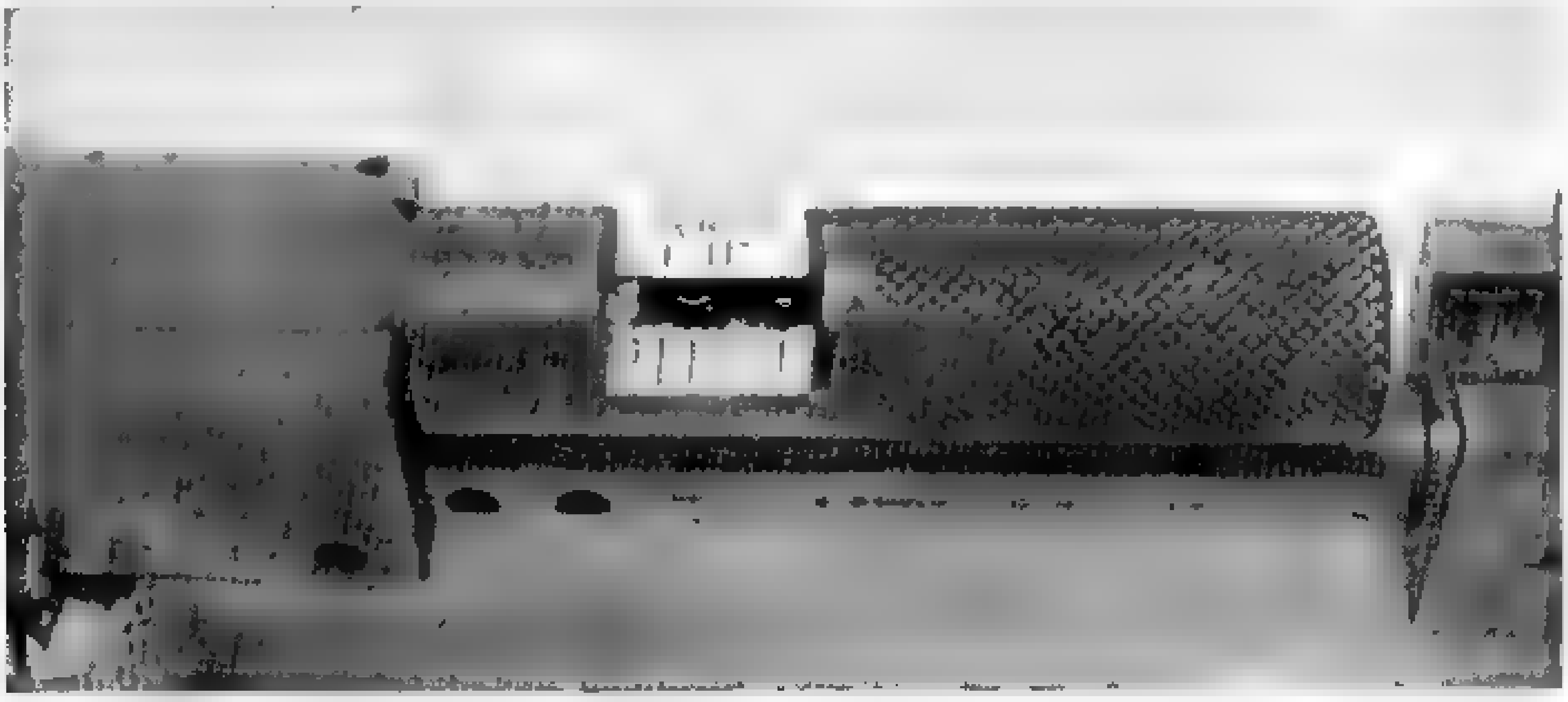
Should rifle cartridges be crimped? That is an interesting question. Most military ammunition, even with metal-jacketed bullets, is crimped. The cannelure on the Springfield bullet is designed solely as a crimping groove. There is no particular reason for handloaded ammunition to be crimped, especially when metal jackets are used. Crimping a case neck on a metal jacket invariably mutilates the bullet, the case, or both. It can never do any good. Jacketed bullets should be seated friction-tight, and this is done through proper resizing and expanding of the shell. The seating of cast bullets creates an additional problem—one that should be treated very seriously. Case necks should be expanded to not more than .001 inch smaller than the diameter of the bullet, and in some cases exact diameter is to be preferred. Extreme care should be taken to remove all burrs

The straight-line bullet seater is by no means new. On the left is a .25/20 single-shot cartridge for which the first commercial rifle was the Maynard. Beside it is a Maynard straight-line bullet seater furnished by the makers of the rifle with their Model 1873 numbers. Beside that is a straight-line bullet seater made in 1873 for the .38 extra long centerfire cartridge used in the Frank Wesson rifle. Note that this tool is in two pieces and is similar in design to the modern straight-line outfit. The large button-top plunger was designed for hand-seating pressure—not a mallet. Modernized versions of these bullet seaters are now manufactured by A. O. Niedner, C. V. Schmidt, Belding & Mull, and many others. This type is usually furnished by the makers of special caliber guns by chambering the block with the same reamer as that used in the barrel chamber

from the mouth of the cartridge case, and this should be accomplished first through the use of a reamer followed by a slight flaring of the mouth. Excessive flaring serves no purpose, and the additional working of the brass causes it to become brittle, resulting in split necks. For rifle use do not crimp bullets unless they must be fed through tubular magazines. The flare, however, should be removed, and this can be accomplished very easily with the average reloading tool merely through the simple process of seating the bullet. If the flare is left on the loaded cartridge, it may be found to be impossible to get it into the chamber.

An interesting angle of the bullet-seating problem is found in connection with the gas-check bullet. Some years ago I saw a very excellent Springfield heavy barrel which had been totally ruined by being bulged and badly scored. The owner said it got that way through using reduced charges with gas-check bullets and strongly condemned the gas check as dangerous. He stated that the tiny copper cups dropped from the bases of the bullets during their flight through the bore and remained lodged there until the next shot was fired. Sometimes, he insisted, these cups were blown out of the barrel by a blast of air forced ahead of the bullet. In this particular case, the cup apparently became wedged in the lands and the following bullet ran over it. The answer to his problem was obvious after a sample of his handloads had been checked. He had seated his gas-check bullets so deeply into the shell mouth that their bases projected into the powder chamber. The forcing of the cast bullet through the case neck in certain instances had caused a swaging of the bullet base to smaller diameter, thus causing the unsupported gas check to fall off the minute it had progressed deeper than the neck of the case. It then floated around on top of the powder charge.

Experimenting with this problem in recent years, the author has found that damage of this kind occurs more frequently than one would imagine. The gas check is blown through the barrel and in some cases has deliberately mutilated the base, mashing it all out of shape and springing the bullet out of true line in the bore. This has been determined by shooting into oiled sawdust and recovering the slugs. These loose gas checks, when they float on top of the powder charge, may or may not be blown clear of the barrel by the force of the blast. If one should remain within the barrel, it is quite probable that the next shot will cause serious trouble. A precaution which every shooter should observe, therefore, is to be certain that the base of his bullet does not project into the case. This is the only way to eliminate all possibility of the cup dropping off. These facts have been mentioned in a previous chapter, but they are of sufficient importance to bear repetition as a warning.



Homemade alterations of Belding & Mull bullet-seating die by A. J. Weinig, Golden, Colorado. A section is cut from the seating chamber, barely exposing the case neck and bullet base. Care must be taken not to remove too much metal. Lines are filed on the flat surface to act as gauges and check the adjustment visually. This also permits air to escape from the seating chamber and prevents the accumulation of grease, which frequently changes seating depth. An excellent idea

Extreme care should also be taken to see that the bullets do not shave on entering the mouth of the case. These tiny slivers of lead can cause serious mutilation of a bullet and in many cases account for barrel leading. Cast bullets, either solid or hollow-point, if intended for hunting purposes other than single-shot loading, should be properly crimped to prevent their being forced into the case

neck through handling or through recoil in the gun.

For the finest of target accuracy, your case should be carefully inspected to see that the walls of the neck are of uniform thickness. Variation here will cause a bullet to be improperly seated and can create serious damage and inaccuracy, although the charge may not necessarily be dangerous to shoot.

The seating of bullets with the various tools is a routine operation which the handloader readily learns from his tool manufacturer's catalog. The final niceties are something else again, and most of these are learned only through experience. An effort should always be made to get straight-line bullet seating, but the unfortunate part of the thing is that even with the so-called "straight-line" tools this is rarely possible. Improper fitting of the resized case in the loading chamber, permitting it to float around or buckle, is noticed in practically every make of tool now on the market.

L. E. Wilson of Cashmere, Washington, gun bug, experimenter and toolmaker (not blacksmith), has designed a straight-line tool, chiefly for the .30/06 cartridge, which is *actually* straight-line. While this tool is designed to straight-line resized shell necks, a modification of it permits it to be used as a straight-line bullet seater. In this, the case body is supported in an especially ground die 1 13/16 inches long and 1 inch in diameter. One inch to Mr. Wilson means 1.000. The body of the tool is bored and reamed to a diameter of one inch. The cartridge case is seated in the die, the shell holder supported along its taper, and this unit inserted into the body of the tool. A plunger, also ground to fit the inside of the body, is then tapped with a wood or lead mallet, forcing the shell into the neck-sizing portion of the die at the opposite end of the chamber. Regardless of wall thickness, it can resize only in a straight line, as the shell body is guided properly and cannot buckle. Shells resized in this manner seat the bullets correctly because the case is guided in a straight line. Mr. Wilson has designed this tool so that the resizing die can be unscrewed and the bullet-seating plunger for true straight-line seating inserted in its place. A further attachment permits of straight-line neck reaming, thus giving neck walls of uniform thickness. Seating bullets with this instrument is by no means speedy work, but no *precision* ammunition has ever been assembled on a speed basis; nor will it ever be.

Very definite experiments have been conducted with both cast and metal-case bullets to prove the theory that you can seriously mutilate the point of the bullet and still maintain reasonable accuracy if the base is not deformed. By the same rule, a mutilated base will ruin accuracy regardless of point form. Harry M. Pope learned this many years ago, and the experiments of Dr. Mann, as recounted in his excellent book published in 1909, quote plenty of facts to substantiate this claim. Furthermore, in Captain Crossman's *Book of the Springfield*, published some years ago, experiments with metal-jacketed bullets show that what is true of the cast is also true of the more modern jacketed form.

The seating of bullets, to be successfully accomplished, depends to no small degree on the way you start your bullet into the case mouth. The bullet should not be carelessly balanced on top of the case mouth, but should be started to the best of the handloader's ability so that it is in a straight line when the plunger descends upon it. If you use a slightly funneled mouth on your case, you will find that cast bullets can be started slightly with the fingers to hold them and then suitable pressure can be applied by the loading tool. Most metal-case bullets need no belling of the mouth to be started, although the bullet should always be started with the fingers to prevent straining the case neck out of line should the bullet tilt at the time the pressure is applied.

In any type of tool, if it is possible to do so, the cartridge case should be held upright during the seating operation. This keeps the powder charge out of the case neck and prevents possible spillage. Certain types of tools, however, are designed to function in a horizontal position, and with this type extreme care must be taken, particularly since hand-started bullets are somewhat inclined to fall out of the case neck.

It is well to remember that the seating of bullets is the final touch in the handloading of ammunition. Upon this operation depends the performance of your finished cartridge just as truly as does any other single step. If done carelessly, your precision weighing and measuring of powder charges, your careful selection of cases and all other work will have been wasted. Study the requirements of your gun and then seat the bullets with care, bearing in mind that they must be used in one particular gun. Skill is acquired not alone through practice but through the combination of study and experience. The skillful man makes mistakes, but he profits by each one. He learns by doing. Be skillful in the seating of bullets.

XIII

POWDER—ITS HISTORY AND TYPES

THE propelling agent used to expel the bullet from the barrel is generally called "powder." This subject is one upon which many volumes could be written without covering it fully even then. Essentially the powder is some form of solid matter—either a granulated cake, an assembly of small porous particles, or a gelatinous substance formed into fine granulations, square, round, disc-shaped, or tubular, as the case may be.

In action, this solid substance receives the flash of the primer and is promptly converted into a gas or gases of many thousands of times the volume the material originally occupied in solid form. This, of course, builds up a pressure; and the gases, pressing equally in every direction, find that the bullet yields more readily than other parts of the gun, and thus is pushed through the rifled tube that the gases may expand into the outer atmosphere.

This propelling agent is divided into two distinct classes—black powder and smokeless powder. The black, generally known as "gunpowder," is a strictly mechanical combination of saltpeter, charcoal and sulphur. It is subdivided into two classes—the genuine black powder and the semi-smokeless varieties. Powders of the latter kind have plenty of smoke but leave less solid residue in the barrel. "Lesmok" is another name for semi-smokeless.

Smokeless powder is also divided into two distinct classes—bulk and dense. The bulk powders are now obsolete, but were of soft granulation and used chiefly in low-pressure cartridges or for reduced charges. Modern "dense" powders have completely replaced them. On the other hand, a powder is never obsolete until the last can has been consumed—and there is still plenty of the old bulk line in the possession of handloaders.

The major group of smokeless powders is known as "dense," since it is of a gelatinized structure. Dense powder may be subdivided into three classes—the single-base or straight-nitrocellulose type, of which the Du Pont IMR series is an outstanding example; the double-base type, as exemplified in most of the Hercules powders; and the triple or "multi-base" powder as seen in Du Pont's newest line and exemplified in Pistol #6, MX Shotgun, and various experimental powders which will soon be released to the market.

Black sporting powder or "gunpowder" is still used in enormous quantities, but rarely by the handloader. With the exception of a few old-time guns, there is a smokeless powder today available to meet every need. It is well to review the progress of black powder that a better understanding of its possibilities may be obtained.

The basis of black powder is saltpeter or potassium nitrate. The first undisputed mention of this substance is found in the writings of the Arabian, Abd Allah, born about 1200 A.D. It is here called "Chinese Snow" and the chronicle indicates that the Chinese used it in Roman candles as early as the tenth century A.D., possibly earlier. In addition, we have the original "Greek fire," which many writers have labeled as early gunpowder. This is totally incorrect; noted researchers clearly state that this was not a saltpeter mixture but an incendiary composition of tow, resin, pitch, sulphur, etc., believed to have been developed in the third century A.D.

Vegetius gives recipes in 350 A.D. showing the addition of petroleum or naphtha. In 673 A.D. *Callinicus* added quicklime to the composition and used it to defeat the Saracens. When wetted with water it took fire. Callinicus used a syphon or wooden tube encased in bronze and thus projected his liquid fire with the hose of a water engine attached. . . .

Friar Roger Bacon (1214-1294) is generally credited with originating gunpowder as a mixture, but he did not know of its value as a propellent. . . . Berthold Schwarz is often called the inventor of firearms, as it is believed he first applied the use of Bacon's formula to the purpose of propelling projectiles. It is known, however, that guns came out in England in 1314. Edward III used guns on his invasion of Scotland in 1327. . . . My notes indicate that in the fifteenth century a pound of gunpowder cost between eight and nine shillings (between \$2 and \$2.50), which may give you a rough idea of its value if you can visualize how much two dollars meant in those days. . . . The same notes further indicate that Bacon's original formula contained 41.2% saltpeter, 29.4% charcoal,

and an equal amount of sulphur. This remained the standard formula in use until 1338, when France improved on it with 50% saltpeter, 25% each of charcoal and sulphur. Twelve years later England again revised the schedule with 66.6% saltpeter, 22.3% charcoal and 11.1% sulphur. From then until 1775 there were eleven distinct formulas representing different eras and different types of guns. The formulas used by the American colonies in the Revolution were developed by Henry Wisner and consisted of 75.2% saltpeter, 13.5% charcoal and 11.3% sulphur.

In 1781 England again revised this formula to 75% saltpeter, 15% charcoal, and 10% sulphur. These latter specifications have remained practically unchanged since that time, and this is essentially the accepted formula for black sporting gunpowder throughout the world today.

Saltpeter, generally known as potassium nitrate, is still widely used for various purposes. Most so-called "blasting powder" is actually a version of ordinary black gunpowder using either sodium nitrate or potassium nitrate, almost identical in action.

On May 19, 1857, Lamont du Pont patented the so-called "B" blasting under the patent number 17,321. This contains 72 parts of powdered nitrate of soda (sodium nitrate), 12 parts of sulphur, and 16 parts of charcoal mixed and granulated in the ordinary way. It was then glazed by rolling or tumbling it in a barrel with black lead for a period of twelve hours.

Authentic historians locate the first American powder mill at Milton, Massachusetts, on the Neponset River. This was just six miles from Boston. From that time on, numerous small powder mills were constructed, some living a reasonable life, others blowing up or ending in other disaster after a few years. It would be impossible here to chronicle all of these.

At the beginning of the Revolutionary War the Americans had on hand in their private stores—and seized in raids on British garrisons—approximately 80,000 pounds of gunpowder. Half of this was sent to Cambridge but was recklessly expended before Washington could take charge, and by the end of 1775 it was nearly all gone. Washington was so very low on powder that at one time, when he was maintaining a thirteen-mile chain of sentries around the British, all within gunshot range of the enemy, not a single sentry had an ounce of gunpowder.

The Revolution, however, was what actually started the powder industry in the United States, or rather in the "Colonies," as they were still called. During the first two and a half years of this war, the Colonies made 115,000 pounds of powder from saltpeter extracted locally. The bulk of this was made chiefly between January and November 1776. Imports, however, furnished most of the needed supplies. From the beginning of the hostilities to the fall of 1777, 478,250 pounds of saltpeter were imported, mostly from France by way of the West Indies. At the same time we also imported 1,454,210 pounds of manufactured gunpowder. This material was paid for by the exchange of Colonial products.

This imported saltpeter was turned into additional gunpowder, making 698,245 pounds. Therefore, the Revolutionary powder mills produced 815,000 pounds of gunpowder during that memorable war—more than one-third the total amount available. Thus, during the Revolution, the Colonial supply of gunpowder was:

	Pounds
On hand through seizures and in private stores	80,000
Made from home-produced saltpeter	115,000
Made from imported saltpeter	698,245
Imported completely manufactured	1,454,210
A total supply of	2,347,455

In 1810 America produced in the still youthful United States nearly 1,500,000 pounds of gunpowder. Maryland stood first with a production of 323,447 pounds or over one-fifth of the total which was manufactured in nine different establishments. Of this amount, three mills near Baltimore produced 312,500. Pennsylvania came second with twenty mills producing 286,556 pounds. Three mills near Philadelphia produced half of the state's total, and the most important of these three was located in Frankford, now the site of the Government's ammunition manufacturing plant—Frankford Arsenal. . . . By 1840 Maryland had doubled its output to 669,125 pounds, but had dropped to fifth place. Massachusetts, low on the list in 1810, had by 1840 risen to first place. . . . Thus was the United States powder industry started. During the Civil War it was destined to grow to more than 100 different manufacturing plants.

In the late '60's and early '70's an organization known as the Gunpowder Trade Association—an amalgamation of various powder manufacturers—was formed. It began a gradual absorption of all the smaller companies, until today those which remain outside of the Du Pont and Hercules outfits can be counted on the fingers of one hand.

Most of the deaths in powder manufacturing plants have been due to the practically total aboli-

tion of black powder and the substitution of smokeless. The latter requires a far more complicated process of manufacture, with enormous plants, expensive machinery, and the maintenance of a laboratory. One of the survivors of the older type, however, is well worth discussing.

On March 7, 1863, the Massachusetts Powder Works was incorporated to operate in Barre. Adolphus Merriam was the first president. In 1864 it bought the American Powder Company of South Acton, which was operating a mill built in 1835 by Nathan Pratt on the site of a sawmill belonging to Abraham Sherman. This is the site of the former plant of the American Powder Mills—one of the last of the black powder factories. This plant was discontinued about 1941. During the Civil War it was a good producer, turning out its capacity of 1000 pounds of powder daily.

On March 20, 1868, the Massachusetts Powder Works changed its name to the American Powder Company. A year later it abandoned the Barre plant and machinery, and all operations were transferred to South Acton. The American Powder Company was sold on August 18, 1883, to the American Powder Mills, of which Addison O. Fay was the first president. At the present time this company manufactures "A" saltpeter blasting powder and black sporting powder marketed under the brand name of "Deadshot." This trademark was inherited from the Massachusetts Powder Works. The plant today has a capacity of 90,000 kegs of black powder a year.

In 1904 a subsidiary known as the American Smokeless Powder Company was organized to manufacture Deadshot Smokeless Shotgun introduced by C. R. Borland, formerly chemist of the American E. C. & Schultz Gunpowder Company. The subsidiary was dissolved in 1922, but the powder was manufactured for approximately ten years thereafter by the American Powder Mills.

There is one other powder which should be considered along with black sporting powder—"cocoa powder." In 1892 the California Powder Works, under the management of W. C. Peyton, son of Bernard Peyton who put the plant on its feet, undertook the manufacture of cocoa powder (brown powder) for the United States Government, mostly for artillery purposes. This was by virtue of an arrangement with the Du Ponts, who had acquired the American rights from the Cologne-Rottweil Powder Works of Germany. The first lot of 10,000 pounds was reported satisfactory and was accepted in June 1893 by the Government at a purchase price of 33 cents a pound. Many tons of brown powder were manufactured until the end of the Spanish-American War, when this type was abandoned by military authorities in favor of the then new smokeless types.

Old-time reloaders will recall that the Du Pont combine was entering into the picture with the formation of the Du Pont Corporation in 1899. In 1902 Eugene du Pont died and Coleman du Pont became president. The firm had acquired extensive stockholdings in many other companies and found that it could get control of a majority of the whole industry if it acquired the then large concern known as Laflin & Rand. This was done that same year. Then came the job of winding up the thirty-odd companies, calling in stock, exchanging it for shares of Du Pont, transferring assets, and formally dissolving these miscellaneous companies. Thus the Gunpowder Trade Association, with all its price agreements, was dissolved in June 1904. In 1907 Du Pont controlled about two-thirds of all the black blasting and three-fourths of the black sporting powder business in the country. Despite this, the smaller firms who refused to be absorbed continued to prosper and new ones entered the field. Between the beginning of 1903 and the end of 1909 thirteen new powder companies came into the field with an average individual output of 400 kegs per day. These thirteen firms turned out an average of 1,483,000 kegs of black powder annually.

In 1907 Du Pont was accused by the Government of violating the Sherman Anti-trust Act. The trial lasted five years and resulted eventually in the breaking up of the Du Pont Company and the formation of the Hercules Powder Company and the Atlas Powder Company, both formed in Delaware in 1912. The Government suit actually started July 31, 1907, and became the longest trial on record

Briefly, the story of the Du Pont organization is this: Eleuthère Irénée du Pont de Nemours was born in Paris in 1771. He came to America and decided to enter the powder business some years later. Returning to France, he organized and got the backing of private capital and the aid of the French Government, who immediately saw that it would hurt British trade. The Du Pont partnership agreement was drawn up April 21, 1801, and provided for eighteen shares of stock at $2000 each.

Jacques Biderman, Catoire, Duquesnoy et Cie, and Necker, the latter a brother of a former French Minister of Finance, each took one share. Archibald McCall of Philadelphia and Pierre Bauduy of Wilmington, Delaware, each had two shares. The New York firm of Du Pont de Nemours Père et Fils, et Cie, had twelve shares. Necker did not

take up his share. The partnership was voted to run until January 1, 1810, and could then be continued or altered in a two-thirds vote of the partners.

The first Du Pont plant was on the Brandywine and consisted of ninety-five acres of land purchased for $6740. Production was started in 1804. In 1805 it supplied 22,000 pounds of powder to the Government, and this was found to be of such fine quality that Secretary of War Dearborn sent 120,000 pounds of Army powder to Du Pont to be *remade,* plus a large quantity of saltpeter to be refined. When the work was completed it proved so satisfactory that he announced in public that thereafter Du Pont would have all of the Government work. Thus was Du Pont launched into the history of the United States Government powder, a contact which in 132 years has never been broken.

The Laflin & Rand Powder Company was organized August 24, 1869, in New York City. It took over several of the Laflin powder companies and the Smith & Rand companies along with some smaller plants.

Another black powder which will be pleasantly recalled by old-timers was "American Rifle" and "Creedmore Rifle." This was developed by Chauncey J. Olds, plant superintendent of the Schaghticoke Powder Company, incorporated March 10, 1858, which operated a plant at Schaghticoke, New York. Olds designed a new powder and was granted a United States patent, #387507, April 17, 1888. His formula specified 75% saltpeter, 9% sulphur, 11.5% willow charcoal, and 4.5% charcoal manufactured from carbonized peas. This powder was popular with expert shooters, both in rifle and shotgun, and was manufactured and widely sold until 1903. Olds was paid $500 a year for his invention and his widow received that sum until her death in 1919.

In 1835 Hazard Powder began its life with the formation of the partnership of Loomis & Denslow, later known as Loomis, Denslow & Co. A small mill was started by this firm at what is now Hazardville, Connecticut, on the Scantic River, east of Enfield. Its first product was so poor that its manager sent to England for powder experts and got William and Henry Prickett, formerly of the John Hall & Sons Gunpowder Works at Faversham, England. These men arrived in the spring of 1836, and by fall had the firm turning out a good grade of powder. In 1837 Col. Augustus G. Hazard acquired a quarter interest and joined the firm. By 1843 Hazard and Denslow had bought out the Loomis brothers and organized a joint stock company under the name of Hazard Powder Company.

The History of American Manufacturers, published in Philadelphia in 1868, says: "At Hazardville, near Hartford, Conn., are the extensive gunpowder mills of the famous Hazard Powder Company who have mills also in the towns of East Hartford and Canton. This company has 18 sets of rolling mills with 36 iron manufacturing wheels each weighing 8 tons, 7 granulating mills, 5 screw press buildings and 3 hydraulic presses of 500 tons each. All are in different and separate buildings. In addition, about 50 buildings are used for dusting, assorting, drying, mixing, pulverizing, glazing and packing of powder. Extensive saltpeter refineries and magazines, cooper shops, iron, woodworking and machine plants are also maintained—in all, about 125 buildings are located at their main works at Hazardville and Scitio extending over a mile in length and a half-mile in width.

"To propel this vast amount of machinery, 25 waterwheels and 3 steam engines are employed. . . . This company manufactures annually over a million dollars' worth of powder of various kinds known as Government, Sporting, Shipping and Mining powder, of which large quantities were at one time exported to Europe."

Colonel Hazard died May 7, 1868, but his business continued for nearly a half-century longer. The census of 1860 gives the value of the company's output as $991,500. The company was too powerful and turned out too high-grade a product to be overlooked by Du Pont. About 1876 the majority of stock control fell into the hands of Du Pont interests, and the concern passed out of the picture with the formation of the Du Pont Corporation in 1902.

XIV

THE MANUFACTURE AND USE OF BLACK AND SEMI-SMOKELESS POWDERS

THE beginner often asks the very logical question—"Why does gunpowder burn?"

The three major ingredients of black powder—saltpeter, charcoal and sulphur—are highly inflammable substances. Charcoal in the presence of oxygen burns with tremendous heat. So does sulphur. Charcoal and sulphur mixed together form a product which works like gunpowder and will burn when ignited with a match. It does, however, require plenty of air to support the combustion. The oxygen in the air enters into combination with charcoal (carbon) to form carbon dioxide gas. The air mixing with the sulphur forms sulphur dioxide gas. Ignition or burning of these is very slow because they can burn only as fast as air is supplied. If a draft of air created by a blower is applied to the burning mixture, it will naturally be consumed more rapidly.

Because of this slow burning, however, it is non-explosive. The addition of saltpeter changes the picture entirely. The instant it is ignited the mass burns all at once without waiting for air. Saltpeter is very rich in oxygen, and upon being heated, gives off this necessary gas in enormous quantities; thus gunpowder, through the ingredient "saltpeter," supplies its own oxygen to control the burning.

Three separate factors are very necessary in any mixture used as a propelling charge for a projectile.

1. It must burn rapidly so that the entire charge is consumed in a maximum of a few thousandths of a second.
2. It must give a tremendous volume of free gas.
3. It must develop a reasonable amount of heat to expand these gases, thus building pressures and forcing the bullet from the barrel.

Black sporting powder is manufactured by mechanically mixing the charcoal, saltpeter, and sulphur in the proper proportions in huge mixers or "wheels," as referred to in the discussion of powder manufacturing plants. Water, of course, is added to form this mixture into a paste, which is finely ground and pressed into a solid cake. After drying, this cake is "granulated" through the crushing process by riding the broken chunks of cake through assorted sets of grooved rollers. It is sifted at regular intervals and graduated on a basis of the size of the granulation. Designation of size of the powder was by the "F" system, "F" referring, probably, to "fine." Sporting gunpowder was made in granulations of Fg, FFg, FFFg, FFFFg and FFFFFg. Fg was the coarsest type, FFFFFg the finest. The latter was rarely used. There was an additional extra-coarse grade sometimes used for big-bore shotguns and Government artillery "blanks," known as "Grade A-1."

These various grades were graduated by straining them through a course screen, thus catching the large lumps and letting the rest fall on a fine screen which permits extremely fine powder to pass through. The screens through which the different grades of powder must pass and those on which they must be retained are given in the following table, the figures representing the number of meshes per running inch in the screen:

Size	*Must Pass*	*Must Not Pass*
Grade A-1	6	10
Fg	14	10
FFg	16	24
FFFg	24	46
FFFFg	46	60
FFFFFg	60	..

Before the sorting process, however, the powder is glazed and polished by half-filling a large wooden barrel with a mixture of sifted powder and powdered graphite and slowly revolving and tumbling the barrel for five or six hours. Thus the sharp, ragged edges of the broken grains are rounded off through contact with each other and the graphite adheres to create a shiny polish to the grains. Following this, they are given the final grading and blending and packed in canisters or kegs for the trade.

Chlorate gunpowders of various compositions have been proposed and patented ever since the Civil War, and even before it. Besides potassium chlorate, they contain almost anything that might be found around the house or laboratory, patents revealing that such materials as charcoal, coal dust, sawdust, coffee grounds, sugar, alum, corn oil, linseed oil, ground bark, charcoal from seaweed, etc., have been incorporated in the various formulas.

Often these mixtures were designed to be made not only in the laboratory but in the kitchen and woodshed, for home consumption. Explosions in the early days of the powder industry and the bursting of guns in the use of these experimental powders were by no means uncommon.

One of these formulas was sold by mail at a price ranging from $100 down to $20, depending on how long one resisted the advertising appeal. If the inventor's letters commenced to come and his price started to tumble, he explained that the powder companies had treated him badly and he wanted to hurt them by starting hundreds of small powder companies throughout the country. This particular formula consisted of 256 parts of sugar and one part of alum in a liquid obtained by boiling 16 parts of coffee in 320 parts of water. To this solution he stirred 320 parts of potassium chlorate and then added 8 parts of alcohol and one part of sulphur. After a fashion, the mixture worked. (Not recommended for the cash customer of this book, but an excellent idea for those who borrow your copy.)

The so-called "white gunpowder" which became prominent during the Civil War was a mixture of about 49 parts of potassium chlorate, 28 parts yellow prussiate of potash and 23 parts of sulphur. It was invented by J. J. Pohl in the middle 1850's. While it lacked many of the excellent propelling qualities of ordinary black gunpowder and was extremely corrosive on the soft iron and mild steel barrels, it simplified the process of cleaning the gun and therein lies its sole virtue. The forerunner of this white gunpowder was Augendre's 1850 development of 2 parts potassium chlorate, 1 part each of sugar and red prussiate of potash.

A freak powder was patented in 1889 under the number 418,552 and consisted of moist mercuric fulminate, powdered soapstone (talc) and a gum solution of black powder to act as a binder.

The first chlorate powders were made in the middle 1780's under the direction of Berthollet, who discovered the salt. A mill at the French Powder Works at Essons was making this salt under his direction when it blew up in 1788, costing many lives. At that time even Berthollet decided that its manufacture was too dangerous and abandoned it.

These attempts were an effort of early inventors to improve upon black gunpowder with the perfection of some material of semi-smokeless variety. During the famous French Revolution the Essons works made a gunpowder consisting of 75% ammonium nitrate, 12½% sulphur and 12½% charcoal. It was slightly better than the saltpeter mixture and left a somewhat lighter residue in the barrel.

Shortly before the introduction of smokeless powders, Professors Hebler of Switzerland and Gaens of Germany took up the semi-smokeless idea again, with the result that a new powder consisting of 38% ammonium nitrate, 48% saltpeter, and 14% charcoal was developed. This was manufactured for a short time under the designation "C-86" by the Rhenish-Westphalian Explosives Works in Bavaria, and by the Chillworth Powder Company in England, an offshoot of the German firm. In England the powder was known as "Chillworth Powder." The United States Government investigated this powder quite thoroughly, but nothing was done because it was found that the hygroscopic (moisture-absorbing) nature of the ammonium nitrate caused corrosion of brass cartridge cases.

One of the earliest of the American powders—erroneously called "smokeless"—was the nitrocellulose powder known as "New Sporting Powder" of the Schultz type (described under smokeless powder).

In 1869 Carl Dittmar came to America intending to make nitroglycerine explosives. Milton F. Lindsley, the former superintendent of the King Powder Company, was associated with him for some years. He states that Dittmar anticipated Schultz's famous wood powder (described under smokeless powder). Dittmar experimented with a smokeless powder made from nitrated cubes of purified wood while he was detailed as a technical director of the Royal Prussian Factory at Spandeau in 1861. He became disgusted with it when he was severely burned through the ignition of a sample he had prepared for a demonstration. In 1863 Dittmar was invited to join with Schultz and was assured that Schultz powders were different, but found them to be practically the same as his own. These two geniuses worked together but were low on funds and soon separated. Schultz went to England to experiment. Dittmar, with a more practical mind, began to make nitroglycerine and dynamite. In 1867 he and Schultz were again in partnership for a few months, but lack of funds once more ended the partnership.

Following this, Dittmar came to America in 1869 and built a small plant at Neponset, near Quincy, to manufacture Dualin—sawdust treated with nitroglycerine, beginning this manufacture in May 1870. His nitrocellulose "New Sporting Powder" of the Schultz type was made by purifying wood pulp by boiling it in an alkaline solution, grinding the pulp with starch, making it into pellets; follow-

ing which they were parchmentized with sulphuric acid. They were then nitrated, neutralized, dried, treated with a weak solution of potassium nitrate, dried again and sieved. Henry C. Squires, a sporting goods dealer in New York, bought some, became interested, raised capital and brought Dittmar to Binghamton, New York, where he began the manufacture of this powder in 1878 along with Dualin.

Dittmar's patent #145403 dated December 9, 1873, reads: "Linen or cotton rags are carefully pulped, cleaned, freed from grease, bleached, etc., and then made into paper, at which time a sugar, mannite or starch solution may be added. The paper is then cut into small pieces and nitrated in the usual way. Soda, saltpeter, potassium chlorate, or nitroglycerine may be added to this nitrocellulose."

In the spring of 1881 the plant blew up, wrecking the town of Binghamton. Operations were then transferred to Hastings-on-Hudson. Dittmar's health was failing, but his powder was good, so Von Lengerke and Detmold, New York sporting goods dealers, formed a company and in 1882 took over the manufacture of Dittmar powder.

Milton F. Lindsley began his operations with Dittmar in 1878, part of the time as superintendent of manufacture, and made many improvements. His United States patent #333872 says: "50 parts nitrocellulose, 38 parts saltpeter, 5 parts charcoal, 3 parts potassium chlorate, 2 parts starch, added as a 7% solution and 2 parts of potassium carbonate." His United States patent #341155 contains a pulverized mechanical mixture of wood fiber, charcoal, bituminous coal, and starch, the mixture being granulated and nitrated with a blended solution of nitric and sulphuric acids. It is then washed and impregnated with a solution of potassium carbonate and nitrate or chlorate and then dried. For example: 71 parts willow, poplar, or other wood fiber, 14 parts willow charcoal burned below 444° C., 5 parts of coal, and 10 parts of cornstarch.

Lindsley also became superintendent of the new concern known as the American Wood Powder Company formed in the reorganization of Dittmar. The first plant was near Jersey City, New Jersey. American Wood Powder was extremely popular. It contained 18% sodium nitrate, 44 to 55% nitrolignin, 20 to 38% lignin (charred), and "humus" 3 to 5% volatiles. It was quite hygroscopic, but this was nearly overcome by the time the company failed in the business depression of 1893.

In 1895 Lindsley joined the King Powder Company as plant superintendent at Kings Mills, Ohio. Together with G. M. Peters, president of the company, he developed a modification of American Wood Powder known as "King's Semi-Smokeless." This was patented January 17, 1899—patent #617766—and contains 20 parts nitrated wood cellulose, 60 parts saltpeter, 12 parts charcoal and 8 parts sulphur. Du Pont has a somewhat similar mixture in the recently-departed Lesmok powder.

Also in the early '90's, "Brackett's Sporting Powder," similar to American Wood Powder, was extremely popular in New England.

Black powders, together with their variations of semi-smokeless variety, have played an important part in the history of firearms. They served their purpose and, thanks to the low pressures created by their burning, are still widely used in certain old-time cartridges, although the chief motive of their manufacture today is for export to foreign countries. Their use, however, doesn't fit into the general scheme of handloading. They are extremely dirty, corrosive to brass cases, necessitating a thorough cleaning or washing of each case immediately after firing, and they also foul a barrel badly, necessitating the use of hot water and a scrub-brush to remove the caked-on débris. Cleaning a gun which has been fired with black powder is a messy job, one which necessitates the wearing of old clothes and the conducting of the ceremony in wide open spaces to prevent the blackened water from staining walls, ceilings, floors and surrounding territory. Its use in a few old-time cartridges will be discussed in a later chapter on obsolete cartridges.

Contrary to the general idea, black and Lesmok powders both are dangerous to make and to handle. The handloader should bear all this in mind and treat them with considerable care. In the days of black powder manufacture, explosions were very frequent, and occasionally serious damage and loss of life was incurred. An example of this was revealed by a former official of the Oriental Powder Company of South Windham, Maine. Although the factory was located in this small town, the executive offices were for many years located in the City of Portland, some fifteen miles away. Explosions occurred at regular intervals, and usually with sufficient ferocity to be heard and felt in Portland. After each explosion, there was a general rush for South Windham and a long line of applicants for jobs of cleaning up débris, rebuilding damaged buildings, *and* operating the rebuilt plants.

Lesmok powder is even more dangerous to make and handle than black powder, and despite the fact

that it was formerly *the* propellant in match .22 rifle cartridges, it is now in complete discard. The makers of this powder and factories loading it would be glad to eliminate it entirely, and look forward with keen anticipation toward its obsolescence and discontinuance.

The handloader who has a supply of Lesmok or King's Semi-Smokeless, must take extraordinary precautions in handling it. Do NOT shake the cans it is stored in. Do NOT leave it in the sun or in damp places. If using it in a gravity powder measure of any standard make, operate the metering chamber handle with a slow, steady movement —NEVER hasty jerks. The slightest spark can ignite it. It should never be handled during a thunder storm, as the air is usually filled with static electricity at such a time, and the filled hopper of powder may become ignited without warning. Also be careful to see that the powder is not subjected to blows. On occasion Lesmok powder, lying loose on an open bench, can be exploded by a blow with a metallic object such as a hammer.

You experimenters who insist on handling Lesmok or semi-smokeless powder will do well to observe unusual precautions. It is better to be safe than sorry.

In the author's capacity of Firearms Editor, he is continually receiving inquiries concerning the home manufacture of black powder—the method of mixing the materials, the granulating and grading. To all such inquiries there can be but one answer: *Home-made black powder is extremely dangerous both to make and to use!*

Yes, black powder can be made at home. Despite the warning, many people will continue to attempt this. Many long years ago, as a youngster, the author made experimental batches of black powder. Some of these were even manufactured with laboratory equipment in a high-school chemical lab. Even with intelligent handling, one outstanding event is still vivid in his memory, despite a quarter-century or more which has passed since the incident.

An experimental batch of about a pound of black powder had been manufactured according to the accepted formulas of the day, and the resulting cake had been dehydrated. A very close friend then undertook the granulation of the cake. The job was nearly completed when a vivid explosion took place, completely wrecking the laboratory. The young fellow engaged in the work lost three fingers of his right hand. One side of his face was badly mutilated. Today he still bears those scars.

Every inquiry of that nature receives a very definite letter of condemnation. Smokeless powder cannot be manufactured at home, since this is a chemical mixture involving thousands of dollars in investment in laboratory equipment. Black powder should never be manufactured at home because of the tremendous dangers involved. If you must use black powder, buy it.

DON'T TRY TO MAKE POWDER!

XV

HISTORY OF SMOKELESS POWDER

THE history of smokeless powder is similar to and closely related to that of dynamite. The essential ingredients of both were discovered at about the same time, but dynamite and similar explosives show but little progress, while smokeless powder, despite its present-day status, is constantly being improved and the coming years will see almost undreamed-of results.

Nitroglycerine was nearly forgotten when Nobel brought out his famous "blasting oil" in 1862 and later his dynamite. Nitrocellulose, however, whose inventor recognized the possibility of using it as a propellent in firearms, was made commercially immediately after its discovery, though serious accidents in its manufacture and use soon compelled governments to restrict its further production.

As early as 1833 Braconnot, a professor of chemistry in Nancy, studied the action of nitric acid on starch and other organic substances and found that when the reaction mixture together with the starch was poured into water, there resulted a white "curdy" precipitate which he called "Xyloidine." After experimentation he found that cotton and linen under the same treatment gave a similar substance which he believed to be identical with Xyloidine as obtained from starch.

In 1838 Pelouze, another French chemist, repeated Braconnot's experiment and found that Xyloidine at 180° C. ignited and burned with very considerable violence. He treated rag paper with concentrated nitric acid having a specific gravity of 1.5, allowing two or three minutes for the acid to penetrate the paper, which was then washed free of the acid in water. Thus was obtained a parchment-like material, impermeable to moisture, and of extreme combustibility. The same compound he obtained on using cotton and linen fabrics.

During December 1845 and the early part of 1846 Christian Frederick Schoenbein (1799-1868), professor of chemistry at the University of Basle, Switzerland, prepared for the first time "Schiessbaumwolle" or guncotton by treating absorbent cotton with a mixture of sulphuric and nitric acids. He communicated his results to the *Naturforschende Gesellschaft* of Basle on May 27, 1846, also reporting the results of the use of it in test firearms.

Schoenbein, like Hudson Maxim, often used his wife's kitchen for his experiments. One day, so history tells us, he was distilling nitric and sulphuric acids on the kitchen stove when the flask broke. He grasped the nearest thing—his wife's apron—to wipe off the mess. In order to prevent the inevitable family conflict he immediately washed the apron, which appeared none the worse for the treatment, and hung it up to dry in front of the kitchen fire, congratulating himself that his wife would be none the wiser. Suddenly there was a great puff and the apron went up in flames. Being a scientist, his curiosity was aroused, and he repeated the experiment with more cotton. This story, incidentally, is *not* universally accepted, but is widely told by historians in chronicling the development of smokeless powders.

Schoenbein's writings give a more technical explanation and show that he employed guncotton in shooting experiments almost as soon as he discovered it. This report was published late in 1846, and as a result the French Academy of Science held a lively discussion as to who really discovered guncotton—Pelouze or Schoenbein. The latter was the first to prepare it in a way that it could be used commercially and first to use it in firearms. He wrote to his friend Faraday in 1846 stating that he expected it would soon universally replace black powder. He almost immediately sold his secret to Austria and in 1846 went to England and demonstrated it before the king, being granted English patent #11407 in the name of John Taylor, an assistant.

John Hall & Sons built a guncotton plant at Faversham almost immediately, but in the summer of 1847 this was blown up with the loss of twenty lives. The plant was never rebuilt and no further work was done in England for sixteen years.

Within a year of Schoenbein's first published work, the principles of our present method of determining nitrogen content were described by Walter Crum, a Scotch chemist, in the *Proceedings of the Philosophical Societies of Glasgow* (1847, p. 163). He used a glass jar eight inches long and one and one-quarter inches in diameter filled with and inverted over mercury. The essential features of our present-day nitrometer are there—the action of the sulphuric acid on the nitrate in the presence

of mercury plus a graduated tube for measuring the gas. Crum analyzed some of his own guncotton and found a nitrogen content of 13.69% by his method.

Guncotton plants were soon established in other countries and one by one they blew up, stopping all development. Austria alone stayed with it. Baron Von Lenk built two plants for the Austrian Artillery and manufactured braided guncotton ropes for use as a propellent in cannon. One plant blew up in 1862, the other in 1865. After the first explosion, the Austrian Government considered the process too dangerous and relieved Lenk from the obligation of secrecy. That same year the British Association for the Advancement of Science appointed a committee to conduct an investigation of nitrocellulose and Lenk laid his reports before them.

Sir Frederick Abel, chemist of the British War Office, also presented his researches, and as a result Thomas Prentice & Co. built a guncotton plant at Stowmarket in 1863 which blew up in 1871. Investigations, however, proved that this explosion was due to sabotage.

Abel also began, back in 1863, to produce small quantities of guncotton for the Government at Waltham Abbey, and his researches definitely showed that instability of the product was due to traces of acid left in the fibrous structure that washing could not remove. He therefore destroyed the fibrous structure by pulping it in a beating engine such as was used by the paper industry, patenting this method in 1865. He also patented the plan to compress nitrocellulose into blocks either with or without a binder. (U. S. Patent #59888, Nov. 20, 1866.)

In 1869 Brown, Abel's assistant, discovered that wet compressed guncotton could be detonated with mercury fulminate. This discovery may mean little to the reader, but it meant a great deal to the development of our later types of smokeless powder.

In 1872 the Waltham Abbey plant was enlarged to produce 250 tons of guncotton per year, mostly of the compressed type. The compressed guncotton was used as a disrupting charge for mines, torpedoes, etc. It was not suitable for a propelling charge because it burned too fast and pressures were uncontrollable.

Smokeless powder can come very close to being traced to the development of Captain Johann F. E. Schultz of the Prussian Artillery, who in 1862 began to make a powder which was patented in the United States under #38789, 1863, using nitrated wood. The *Scientific American* in 1865 stated that Schultz cut selected hardwood into sheets or veneer of a thickness equal to the diameter of the finished grain—about 1/16 inch—in small-arms powder. These sheets were reduced to small rods of a diameter slightly smaller than the thickness of the sheets and then re-clipped into small grains or cubes. The grains were purified by a treatment with an alkali or by chlorine and then nitrated in a mixture of 40 parts of strong nitric acid and 100 parts strong sulphuric acid at the rate of 6 parts of wood to 100 parts of acid mixture. The nitrated wood was then freed of excess acid by centrifuging or whirling it in a large rotary dryer, similar to the idea employed by present-day clothes-washing machines. It was then washed in water, boiled in a diluted soda solution, re-washed and impregnated with a solution of potassium and barium nitrate or potassium nitrate alone and then dried. Such a powder containing metallic nitrates is not strictly smokeless but produces much less smoke and is much more powerful than an equal weight of black powder.

"E. C. Powder," patented by Reed & Johnson for the Explosives Company of England in 1882, is somewhat similar except that nitrated cotton is used instead of nitrated wood pulp. Both powders have been considerably modified and improved and are still manufactured in Europe. American "E. C." and American Schultz both have been discontinued for many years.

A special type known as "E. C. Blank Fire" formerly colored bright pink, recently orange, is manufactured by Hercules. This is an extremely fast-burning powder and cannot be used to propel any form of projectile. Its sole purpose is in the loading of smokeless-powder blank cartridges.

Many of these early smokeless powders are quite interesting. "J. B. Powder," patented by Johnson Borland in England in 1885 and first manufactured in 1888, used camphor as a hardening agent, instead of ether, as in the earlier powders. Abel in 1865 patented powder grains made of nitrocellulose pulp treated with binders, among which he mentions collodion solutions, mixed in a vibrating vessel (British patent #1102). . . .

Prentice of the Stowmarket factory proposed in British patent #953, 1866, to inlay the threads of nitrocellulose with threads of un-nitrated wood or to reduce them together to a pulp. For sporting powder he made an explosive paper containing 15% of cotton and 85% guncotton fibers which was cut into strips one inch wide and rolled into tight wads to fit the cartridge cases. About 30 grains by weight constituted the charge for a one-ounce (437.5 grs.) bullet. The paper, however, absorbed

moisture, changing the ballistic properties. To obviate this difficulty the rolls were coated with a thin film of India rubber, but this soon dried out and cracked and was not extensively used. . . . Meantime—as early as 1846—Schoenbein had used an ether-alcohol solution which he called "liquid glue" or "liquor astringens" to gelatinize guncotton. . . .

J. Parker Maynard, a Harvard medical student, in 1848 began to use an ether-alcohol solution in medicine as a dressing for wounds. In 1851 Scott Archer used the same solution in photography. . . . In 1869 John Wesley Hyatt of Albany, N. Y., patented the use of camphor heat and pressure in producing celluloid from nitrocellulose. It was found that nitrocellulose so gelatinized by solvents burned less rapidly and more uniformly than loose or compressed guncotton, and this observation probably led the French chemist Vieille to the development of the first gelatinized smokeless powder in 1884.

The first gelatinized smokeless powder was used in the Lebel rifle, Model 1886, and was called *Poudre B* after General Boulanger. This is a mixture of soluble and insoluble nitrocellulose gelatinized with ether-alcohol and contains no nitrates or nitroglycerine. The French Government kept its composition a secret but permitted the manufacture, sale and export of *Poudre BN,* a similar but inferior powder containing metallic nitrates. . . .

According to Oscar Guttmann, the well-known explosives expert, who was killed in an automobile accident in Brussels, Belgium, in 1914, smokeless powder of the modern type, *i.e.,* of completely colloided nitrocellulose, was invented in 1870 by Frederick Volkmann of Vienna. Around 1870 or 1871 Volkmann applied for patents which were granted as Austrian #21208 and #21257 in 1871. Owing to the fact that Austrian patents at that time were not published, the world at large learned nothing of his gun inventions.

However, his company with the imposing name of "Volkmann K. K. Priv. Collidin-Fabriks Gesellschaft, H. Pernice & Co.," was formed, and a plant built at Marchegg near Vienna. The company also secured the Schultz rights for powder manufacture in Austria and began to manufacture both Schultz and Volkmann powders. In Austria, powder manufacture was a Government monopoly, and when the Imperial Austrian High Command learned that Volkmann was making sporting powder without permission and without paying the customary heavy license fees, they stepped in and closed his plant in 1875. Volkmann, therefore, never received anything for his invention and dropped entirely from sight. From that point on, nothing apparently is known of his activities.

Volkmann powders clearly outlined the principles of smokeless powder manufacture by gelatinization and described the properties which *present* nitrocellulose has. If the Austrian War Department, High Command, Imperial Government, or whatever they chose to call themselves, had paid more attention to Volkmann and had perfected the methods of manufacture which he introduced, Austria could have had smokeless powder twelve years before any other country!

In his research on the subject, Guttmann inquired about it among officials. The reply to his letter was typical of political executives in every country, indicating that the breed is invariably short-sighted. The Austrian War Department wrote Guttmann claiming that Volkmann powders were lacking in proper qualities, very imperfect, and so irregular that they were useless for military purposes. However, the patent specifications speak for themselves.

Volkmann's powder was made from nitrated wood prepared according to Schultz methods. It was then treated with a mixture of 5 parts of ether and 1 part of alcohol for 30 minutes and the resultant paste dried for 12 hours at from 19 to 30° C. The plastic was then placed in special moulds to obtain any desired shape and further dried for 24 hours at 30° C. and an additional 24 hours at 50° C. This, according to Volkmann, has the consistency of wood. By treating the nitrolignin (nitrated wood) for a longer time with the solvent "and thereby dissolving the ligneous fibers in the interior more or less," and by varying the moulding pressure, he regulated the gas production of the powder *on a mathematical basis.* This is done today!

Volkmann made three kinds of powder. One of these was yellow in color; no solvent was used in it. A second was brown; it received a solvent treatment of a few moments only, and was superficially gelatinized. A rare sample of this powder is in the writer's collection, and despite its age of some 65 years, it appears to be perfect and free from any signs of decomposition. The microscope verifies this finding. A third, also brown, was made compact and in any shape by longer treatment with the ether-alcohol solution and by moulding.

Volkmann claimed the following properties for his powders:

1. Transparent smoke
2. Less noise than black powder

3. Small residue in the barrel which was readily removed by the following shot
4. One-half the quantity of powder carries the projectile one-third farther with a velocity one-fourth greater
5. Trajectory of the projectile is reduced by one-half
6. The effect of the powder is constant—no variations as in black powder due to crumbling of powder grains
7. No danger in manufacture
8. No danger in storing, as it explodes only if confined, otherwise it burns with a clear flame
9. No danger in transportation
10. Not injured by humidity. If accidentally wetted, it needs only to be dried to make it fit for use

For his completely gelatinized powder (types 2 and 3) Volkmann claimed further that the volume was reduced, that they were not hygroscopic at all, and that they had in small volume as great a power as any known explosive. . . . All of this might be written of *modern smokeless powders* except that nitrocellulose powders are slightly hygroscopic and their power is impaired by exposure to humid conditions.

In 1887—some seventeen years later—Alfred Nobel, who had brought out his now famous blasting gelatine in 1875, stimulated by his study of celluloid, found that by greatly increasing the percentage of nitrocellulose in his blasting gelatine he could produce an explosive which would serve as a propulsion agent. His British patent #1471, dated 1888, specified a mixture of 100 parts of nitroglycerine, 10 parts of camphor, 200 parts of benzol, 500 parts of soluble nitrocellulose. The pasty mass is rolled between cylinders heated to 50 to 60° C., whereupon the benzol evaporates. The mass is then rolled out into sheets and cut into square grains or flakes.

Another Nobel-suggested mixture contains 100 parts nitroglycerine, 10 to 25 parts camphor, 200 to 400 parts amyl acetate, and 200 parts soluble nitrocellulose. The use of camphor was later abandoned because of its volatility, and a stabilizer was added. Nobel called *this* powder "Ballistite" and the Nobel factory at Ardeer, Scotland, first produced it in 1889. American Ballistite, under practically the same formula, bore U. S. Patent #456508, dated July 21, 1891.

About the same time—1889—Hiram Maxim (later Sir Hiram) obtained British Patent #4477, 1889, and U. S. Patent #434049, 1890, for a smokeless powder consisting of guncotton with 10 to 16% nitroglycerine and 1 to 4% castor oil, using acetone as an assisting solvent.

Both inventors submitted their powders to the Explosives Committee, consisting of three chemists —Sir Frederick Abel, Sir James Dewar, and Dr. Dupré. This committee was appointed by the British War Office to recommend the best powder to be used in British military service. They modified Nobel's formula by substituting service guncotton for his soluble nitrocellulose, using acetone as the assisting solvent to bring about the incorporation (British Patent #5614, 1889). They fixed upon 58% of nitroglycerine and 37% of guncotton, and added 5% of vaseline or mineral jelly to lubricate the gun. This formula was granted the U. S. Patent #409549, August 20, 1889. The paste thus produced was squirted through a die to form strings or cords. Under the name of Cordite, this became the British service powder.

At a later date the percentages were reversed, and the present Modified Cordite or "Cordite MD" contains 30% nitroglycerine, 65% guncotton, and 5% mineral jelly, incorporated by means of acetone.

Both Nobel and Maxim sued the British Government for infringement of their patents, but were unsuccessful, the courts holding that Nobel's patent did not cover the use of insoluble nitrocellulose, and that Maxim had confined himself to lower percentages of nitroglycerine, while his castor oil was different and was used for reasons that were different from those governing the use of mineral jelly.

The Germans adopted a modified smokeless powder containing ½% diphenylamine, and Krupps announced in January 1890 that they had been using smokeless powder for all calibers for fifteen months. Also, in 1890, Professor Mendeleef began his researches on nitrocellulose for the Russian Navy which led after large-scale trials in 1895 and 1896 to the adoption by Russia of a completely gelatinized (with ether-alcohol) pure nitrocellulose powder. He called it "Pyro-Collodion" and his powder contained 12.44% of nitrogen and enough oxygen to burn completely to water, nitrogen and carbon monoxide.

Originally—and still widely practiced abroad—smokeless cannon powder was manufactured in strips, ribbons, solid or single perforated rods. Based on the American experiments in 1861 with the "Rodman Cake Cartridge," a form of black powder designed by General Thomas Jefferson Rodman, smokeless powder began to take a form used in Rodman's famous development—a large cake or rod with multiple perforations designed for artillery use. Therefore, America introduced the

perforation system not only for black powder but also for smokeless varieties. Today, more than half of our modern sporting and all military powder is of the perforated type, *i.e.*, its grains are formed in the shape of small tubes.

Many early attempts were also made to build progressive-burning powder. In 1897 Dr. Carl Walter Volney patented such a powder containing nitroglycerine and trinitrocellulose, in which the trinitrocellulose was reduced on the surface of the grains to dinitrocellulose by treatments with sulphites or other reducing salts. It was not successful.

Later, the Germans coated rifle powder with substituted ureas such as centralite. The Chillworth Powder Company of England also made such a powder. Du Pont followed with a similar powder consisting of a mixture of soluble and insoluble nitrocelluloses colloided with ether-alcohol and coated with dinitrotoluene. This was the foundation of the Improved Military Rifle series (IMR) of today.

XVI

SMOKELESS POWDER DEVELOPMENT IN THE UNITED STATES

IN 1890 the United States Smokeless Powder Company was organized by Samuel Rodgers, an English physician practicing in San Francisco. Two years later he obtained a patent for his ammonium picrate nitroglycerine, an ammonium nitrate smokeless military powder. His company merged with the Giant Powder Company that year, and his formula was changed two years later. In 1894 his formula specified 55% ammonium picrate, 25% sodium or potassium picrate, and 20% ammonium bichromate. It was too difficult to pulverize the potassium picrate, so the highly pulverized ammonium picrate was mixed with a concentrated solution of potassium bichromate in the proper proportions, resulting in the formation of potassium picrate and ammonium bichromate in microscopic crystals. These were broken up, screened, and the sifted grains coated with picric acid or dinitrotoluene. The result was the famous but little understood "secret" formula marketed as "Gold Dust Powder." It was intended mostly for shotguns and was loaded by all the loading companies of that period, but was none too popular because it classified in the present-day "dense" group and could readily be overloaded, thus causing the bursting of many guns. Old-timers who may read this will distinctly recall its obnoxious odor on firing. In 1898 the plant was destroyed by an explosion and was never rebuilt; thus Gold Dust Powder disappeared from the American field.

Another bygone powder, manufactured by the Economic Smokeless Powder Company of Illinois about 1898, bore the name "Velox" and was composed of 50 parts ammonium picrate, 50 parts barium nitrate, and 15 parts picric acid. It was short-lived, as the company failed the following year. Francis A. Hasley, formerly of the U. S. Powder Company and with the Economic Powder Company, joined the staff of the Robin Hood Powder Company of Swanton, Vermont. Edward Dickson of that firm in 1896 had patented powder consisting of barium nitrate, potassium chlorate, picric acid, liquid ammonia, potassium ferrocyanide and flour. The Swanton plant began its operations about 1899. Two years later Dickson patented a similar powder using ammonium picrate instead of the liquid ammonia and picric acid. After graining, this powder was coated with petroleum which had been successively treated with nitric acid, sulphuric acid, and ammonia.

The outlet for sporting powder was so small that in 1900 they began the manufacture of metallic cartridges and employed Charles G. Worthen, formerly of the Creedmore Cartridge Company of Akron, Ohio, as superintendent of that department. The firm was reorganized in 1906 under the name of Robin Hood Ammunition Company, which it retained until 1915, when it sold out to the Union Metallic Cartridge Company. At that time the manufacture of powder was discontinued. During the World War, Remington operated the Swanton plant for the manufacture of the 8-mm. Lebel rifle cartridge under contract with the French Government, turning out many millions of these cartridges.

The famous "Peyton Powder" of the California Powder Works used by the Army in Krag shells during the nineties consisted mostly of nitroglycerine, nitrocellulose and small amounts of ammonium picrate. The writer has received many requests for the identification of this powder as extracted from Krag shells made during the nineties by Frankford Arsenal. All of these early Krag cases were tinned inside and out before loading, to reduce the corrosive effect of any small quantities of free acids left in the powder.

Breakdown tests performed a year ago on Krag cartridges loaded at Frankford in 1893 showed that after more than forty years this powder was in good condition and appeared to be free from traces of decomposition. However, samples of it in storage in the writer's collection for the past three years had shown unmistakable signs of decomposition and were destroyed as a matter of safety.

Later, the Army adopted ammonium picrate as a bursting charge for its shells under the title "Explosive D," named after Colonel W. B. Dunn, its proponent. This "Explosive D" was used primarily as a bursting charge for mines, projectiles, etc., and was a fine-grained flour somewhat mealy and oily to touch, and of a dirty yellow color. Various modifications of it bore such names as Triton and Dunnite, but ammonium picrate in

itself was soon proven to be totally unsuited for use as a *propellent*.

American Smokeless Powders. The year 1890 actually marks the start of smokeless powder manufacturing in the United States. In that year the Anglo-American E. C. Powder Company was formed with its plant at Oakland, New Jersey. The same year saw the U. S. Navy start the development of smokeless powder under Professor Monroe at the experiment station in Newport, Rhode Island. By 1898 Navy powders had reached a stage of development where a large manufacturing plant was required and established at Indian Head, Maryland. In 1891 Du Pont built the guncotton plant at Carney's Point, New Jersey, where in 1893 the manufacture of Du Pont Smokeless Shotgun powder was started. Also in 1893, after several years of experimentation, the rifle powder of the California Powder Works at Santa Cruz and the Leonard Powder Company at Bay Chester, New York, came into production, and these products were found to be of sufficient merit to get an Army contract.

A rare booklet in the writer's collection, published by the Leonard Smokeless Powder Company September 20, 1893, indicates that this firm's New York offices were located at 622 Temple Court and 5 and 7 Beekman Street, and that it was incorporated under the laws of the State of Tennessee; with capital stock of $10,000,000 divided into one million shares having a par value of $10 each. John Hamilton Brown was the first president of this firm. M. E. Leonard was superintendent of powder manufacture. Mr. Brown was also mechanical engineer, and Lieut. G. N. Whistler of the United States Artillery was ballistic engineer. Despite its "enormous capitalization," this 1893 statement says in part: "Already 1400 of the 5000 *preferred* shares have been sold." No reference is made to the sales of any common stock. This old document says: "During the fiscal year 1892 the Ordnance Department of the United States Army purchased over 450,000 pounds of gunpowder, about 580,000 pounds Emmensite, 16,000 pounds of dynamite, and some 624,000 rounds of fixed ammunition. The use of explosives in the Navy is much greater in amount than in the Army . . . the sale of sporting powder is very large both of the black and of the smokeless variety, and a conservative estimate of the total U. S. sales for this purpose places the amount at not less than 3,000,000 pounds per annum. . . . Leonard Powder will be sold at a profit at a price which will be relatively less than that of black powder, since one pound of Leonard Smokeless is equal in ballistic value to three of black."

These figures refer to American powder consumption in the days when crime was very light and before the advent of the wildcat politicians and reformers concentrating upon foisting absurd antifirearms laws on a non-resisting public.

The Leonard powders were developed as "Ruby N" and "Ruby J." They belong to the Nobel type of smokeless powders, several of which were well known in that period under the names of Cordite, Ballistite, Maxim and Houghton powders. According to the Ordnance Department test report given in the 1893 brochure, the following factors of efficiency for various smokeless powders tested in small arms and the pressure guns at Frankford Arsenal and Springfield Armory rated Leonard's "Ruby" at 117%, Maxim's (American) at 106%, Houghton's (American) at 103%, Troisdorf (Austrian) at 96%, B. N. (French) at 96%, Nobel's (German) at 95%, Wetteren (Belgium) at 93%, Cordite (English) at 93%, Du Pont (American) at 87%.

The actual manufacture of some of these early experimental powders was started by the California Powder Works in 1894, closely followed by Du Pont with a similar powder. Leonard, despite the excellence of their powder, ran into financial difficulties and fell far short of their mythical "$10,000,000 total capitalization." The firm failed, and its successor, the American Smokeless Powder Company, with $30,000 capital loaned by Laflin & Rand, built a plant at Pompton Lakes, New Jersey, in 1894, and began Government deliveries. In 1897 all three companies started to make a double-base (nitroglycerine) cannon powder for the Army.

Essentially, the early Leonard powders were manufactured in the old Dittmar plant at Baychester, New York, leased for the purpose. The first formula called for 58% nitroglycerine, but this gave trouble from exudation of the oily fluid, and the formula was changed to 35% nitroglycerine and 65% nitrocellulose. In the development of this Ruby Powder, Lieut. Whistler, together with the factory superintendent, Henry Churchill Aspinwall, designed the famous "W. A." powder for the Krag. . . .

In 1898 the company got into financial difficulties again and was taken over by Laflin & Rand to protect their $30,000 "mortgage." L. & R. had become interested in smokeless powders through having acted as American agents for Troisdorf powder. Back in 1893 they had negotiated for the American rights to Ballistite, but since Nobel asked £60,000 (about $300,000) plus royalty, they re-

fused it at that price. . . . Shortly after the change in ownership an explosion wrecked the factory, but the board of directors voted the following day to rebuild it. Work was started a short distance from the old plant, and a new factory capable of a daily production of 6000 pounds of smokeless powder plus an additional 1000 pounds of guncotton was soon in operation. Since J. A. Haskell was president of Laflin & Rand, the town name was changed at this time.

The Haskell plant is historic and significant since here were born some of the best powders ever produced, powders which are still among today's best bets for the handloader. L. & R. developed Lightning, Sharpshooter, Unique and L. & R. Smokeless. Samples of the last-named powder in my collection indicate that its grains were round orange discs. Later the form was changed slightly and graphite added to color it black instead of the orange or amber semi-transparent grains, this "new" powder being called Infallible. The famous "Sharpshooter" was designed to replace black powder in the .45/70 Government.

In 1909, at Haskell, the plant (then Du Pont-operated) began the manufacture of Ballistite under agreement with Nobel. It also developed new methods of manufacture. Ballistite is very similar in composition to Infallible, differing mostly in method of manufacture. Infallible is formed in rods or strings, and cut into discs by rotary knives, whereas Ballistite was rolled into sheets and cut into small squares or "flakes," as they are generally known. This flake system of manufacture is widely used in foreign countries, even today. The original American Ballistite, however, was cut into small hexagonal flakes by an ingenious cutter designed by M. P. Wilkins in which a knife was made to travel at right angles across the sheet of powder while this moved at constant speed over the cutting table, thus making an oblique cut. On the return stroke of the knife, the cut was made at an angle of 120° with the first. The square form was finally adopted, however, because it seemed to be as satisfactory ballistically as the hexagonal, and was easier to cut uniformly. . . . In 1912, when the Du Pont Company was dissolved, the double-base powders went to Hercules, and Ballistite alone of the family to Du Pont. This Haskell plant was active until 1926, when it was permanently closed and dismantled.

The United States Navy was among the first to recognize the value of nitrocellulose powders. It had experimented with straight "single-base" powders as far back as 1897, and in that year invited private manufacturers to produce this powder commercially. The California Powder Works and Du Pont began at once, and first deliveries came along in 1898. Navy powder production was soon started at Haskell. Also in 1898 the International Smokeless Powder Company was formed to make first Dr. Volney's powder and later (1900) the Official Navy Smokeless.

It is interesting to note that during the Spanish-American War, few United States ships could use smokeless powder. The Army had fair stocks of smokeless rifle powder, but the only naval ship to have smokeless for its heavy guns was the *New Orleans*. This was Cordite of foreign manufacture. Most of the ships used Brown Prismatic or Cocoa Powder, but the freedom from smoke and accuracy of firing as established by official records of the *New Orleans* were so remarkable that after the war the Army and Navy discontinued all contracts for the Brown Prismatic Powder.

From 1900 on, the game became one of consolidation with Du Pont. In 1914 the total capacity of American plants for smokeless cannon powder was about 40,000 pounds per day. At the time of the Armistice, American plants were producing very nearly 4,000,000 pounds per day.

American E. C. & Schultz Powder Company. Winchester first began to load American E. C. and Schultz powders in 1893. The British Company sent Capt. Albert William Money to the United States, and his favorable report was responsible for the formation of the Anglo-American E. C. Gun Powder Company in 1890. Plants were constructed that year at Oakland, New Jersey. Winchester, therefore, was the first American ammunition factory to load smokeless powder.

The original E. C. powder was, of course, a shotgun propellent and was a mixture of soluble and insoluble nitrocellulose. A single grade of nitrocotton was used with 38% to 40% nitrates (about 1/10 potassium and 9/10 barium nitrate) with small amounts of starch and paraffin oil. The grains were hardened with a mixture of ether, alcohol and gasoline and colored with aurine. Later, alcohol with a trace of camphor was used as a hardening agent, and partial solvent recovery was practiced with direct distillation. This is a manufacturing process and need not be discussed here. The nitrocellulose content of this powder was later increased and the nitrate content decreased.

The first E. C. Powder made at Oakland was similar to the English powder and weighed 42 grains per 3-dram load. This was followed by a Schultz powder which differed very little from it and was also a 42-grain powder. New E. C. and

New Schultz came later and weighed 36 grains for a 3-dram load. The firm also developed "blank-fire powder" and a Smokeless .22-caliber rifle powder. "Marksman" rifle powder for mid-range shooting was a still later development. In 1904 New E. C. and the 36-grain Schultz was discontinued and a New E. C. Improved came out weighing 42 grains. During this time the new Schultz together with New E. C. Improved became the regular product of the company.

Late in the fall of 1903 Du Pont took a 99-year lease on the property of the American E. C. & Schultz Powder Company, Ltd., at a rental rate of £3750 (about $18,750) with option of purchase. In the spring of 1904 the lease was assigned to Laflin & Rand. Du Pont operated the plant until the late fall of 1909, when the powder equipment was transferred to Carney's Point, New Jersey, to cut the manufacturing cost. Both E. C. and Schultz powders were made there until 1923, when the manufacture was taken over by the Kenvil, New Jersey, plant of the Hercules Powder Company. This company had actually acquired title to that plant in 1912 by a court order dissolving the old Du Pont Company. These are actual facts, although they seem to be considerably muddled. The powder industry of the United States is so thoroughly interwoven that it is difficult for a historian to state definitely "which firm was which and when."

Stepping backward again to the year 1894: Following the tests previously described in the folder on Leonard powders, the United States Army made public its first formal request for smokeless rifle powders for the .30-caliber Krag cartridge. On November 4, 1894, the Army requested bids on a lot of 10,000 pounds. Specifications were more or less general and gave merely the dimensions of the cartridge case and bullet; a velocity of 1960 f.s. at 53 feet was desired, with a mean variation of but 20 f.s. in 40 rounds and a maximum pressure of 38,000 pounds.

"This powder must be free of dust, smokeless, must not corrode barrel or cartridge case or require an unduly strong primer or leave a hard adherent residue in the barrel," specifications said. "It must not be sensitive to shock or friction or be so friable as to break up in transportation. It must permit of machine loading with variations not over 3/10 grain in 50 consecutive loadings. It must not give excessive heat in rapid fire. Preference will be given to American powder and those of nitrocellulose types." The contract was divided between the California Powder Works and Leonard.

In the fiscal year ending June 30, 1894, Frankford Arsenal examined twenty-five varieties. Albert Smith of New York, H. P. Weidig of New Jersey, Frank Neidl of California, Laurence Volney, Maxim, Shupphaus, Whistler & Aspinwall, Savage Repeating Arms Company, and numerous others submitted powders "useful only to their makers," says the Chief of Ordnance report for 1895.

In 1898 the famous W. A. powder, named after Whistler and Aspinwall of the Laflin & Rand Powder Company, which absorbed the American Smokeless Powder Company, became a strong competitor of the nitrocellulose types on account of excellent ballistics despite high erosion. However, the powders of this type (W. A. .30-caliber) contained 30% nitroglycerine and became the standard service powder from the first delivery to Frankford Arsenal, July 19, 1895, and enjoyed formal adoption from 1896 until 1908, when nitrocellulose came in under specifications of April 18, 1908. This should clearly indicate that, with the exception of possible experimental batches, the early Model 1903 cartridge and the later Model 1906 type using the Spitzer bullet were developed and founded ballistically *on their performance with the W. A. powder!* These 1908 specifications not only gave the composition of the powder upon which bids were asked but also gave detailed description as to manufacturing methods.

Since the early part of the nineteenth century the War Department had tried to get its own powder factory, and this was granted in 1906, when Congress appropriated $165,000 for the construction of a plant with a capacity of 1000 pounds per day, near Wharton, northern New Jersey. This land had been purchased in 1890 and used as a powder storage depot. Major B. W. Dunn drew up plans, and construction was started in February 1907. In June he was ordered to duty with the American Railway Association in connection with the organization of the Bureau of Explosives, and Major Odus C. Horney took charge. Manufacture began in 1908 on cannon powder at the rate of 1000 pounds per day. In 1909, arrangements were made to add production of 250 pounds of small-arms powder, and after 1910 the plant was gradually increased in size to produce 10,000 pounds per day. Also, an experimental plant for the manufacture of high explosives was erected. Horney resigned with the rank of colonel in 1915 to take charge of the smokeless powder work of the Aetna Explosives Company and was succeeded by Col. John W. Joyce. This powder manufacturing depot became known under its present designation—"Picatinny Arsenal."

Originally all smokeless powder tests of the Government were made at Frankford Arsenal, first under Captain Pittman and Lieut. Dunn (later Colonel Dunn). In 1903 the testing of cannon powder was transferred to Sandy Hook. In recent years all ballistic tests of small-arms powders are made at Frankford Arsenal. Picatinny handles chemical tests on all kinds of smokeless powders. The proof and ballistic tests of cannon powder are conducted at the big proving ground at Aberdeen, Maryland, established in 1918. A range was constructed there for the testing of small arms as well. All of which brings us up more or less to the beginning of the World War.

When the war came on, the Government found problems in plenty. It was planned to construct two large Government plants in addition to the various commercial organizations, these two Government plants to have a combined capacity of 1,500,000 pounds of smokeless powder *per day.* One location was at Old Hickory, near Nashville, Tennessee; the other at Nitro, West Virginia, just below Charleston. The contract for the construction and operation was given to Du Pont and a subsidiary firm was formed known as the Du Pont Engineering Company. Construction was started in March 1918, and the first powder granulated in September. The plant was built and came into production in units of 100,000 pounds each under the able direction of E. F. Johnson, engineer and general manager. At the time of the Armistice, five units had been constructed and the plant was producing half a million pounds of powder daily.

The Charleston plant was built under the direction of D. C. Jackling of the Ordnance Department. Du Pont furnished the plans, and the designers were Graham, Anderson, Probst & White, architects of Chicago. Work of construction was conducted under contract to Thompson-Starrett Company, and the Hercules Powder Company was placed in charge of operations with Leavitt N. Bent as manager. At the time of the Armistice this plant was 60% complete and was turning out 175,000 pounds daily.

After the war, these plants, being useless, were dismantled and sold. Many of the buildings were retained for the storage of surplus powder. The entire village of Old Hickory was purchased in 1924 by Du Pont for the manufacture of artificial silk (rayon).

On August 10, 1924, a fire started in one of the solvent recovery buildings at Old Hickory in which part of the War Reserve powder was stored. Fire engines broke down and the fire gained rapid headway. It destroyed 106 buildings and 50,000,000 pounds of powder. There were no fatalities and the only man injured was the guard who discovered the fire. He was caught in one of the first blasts of flame about 150 feet from the burning material. The intense heat ignited material and other buildings 400 feet away.

Hercules Powder Company. Although this was a Wilmington, Delaware, corporation, formed in 1912 when the Federal Courts dissolved the Du Pont trust, its main smokeless powder plant was located at Kenvil, New Jersey, its present site. Kenvil was formerly McCainsville, where a dynamite plant had been operating since 1871. When Hercules was formed, it had no equipment to make smokeless powder; this was provided, and land at Kenvil placed at its disposal. Until the equipment was ready, Du Pont continued to make "Hercules" powders, but the Hercules organization sold them. New equipment was ready in February 1913, and E. A. W. Everitt was transferred from Du Pont to the new plant at that time. Bernhart Troxler, formerly in charge of the Ballistic Laboratory at the Haskell (New Jersey) plant, became assistant superintendent in August of that same year, and L. C. Weldin was transferred from the Du Pont Experimental Station to take charge of the Ballistic Laboratory, where he remains today.

The original plans of Hercules called for daily production of 1500 pounds of shotgun and rifle powder, but it was soon found easy to increase production to 2000 pounds. Nitroglycerine came from the regular production of the dynamite plant, but it was cheaper to buy nitrocellulose because of the small amounts needed. For a time "E. C." powders were made elsewhere on contract. After the World War, when Hercules came into possession of a wartime nitrating plant, it began to manufacture its own nitrocellulose at Parlin, New Jersey, for these powders as well as for gelatine dynamites (1919), and in 1923 built an E. C. powder plant at the Kenvil works. . . .

It will be seen, therefore, that when Hercules was formed the brands becoming their property were E. C., Bullseye, Infallible, W. A. .30-caliber, HiVel, Sharpshooter, Lightning, Unique, Bear and Stag. When the World War broke out, Hercules, being familiar with the manufacture of double-base powders through their inheritance, secured enormous contracts for Cordite, none of which had been previously manufactured in the United States. The Kenvil plant was enlarged to produce 12,000 pounds of Cordite per day for the British Government and its engineers incorporated numerous improvements into the design of the equip-

ment which speeded up production and lowered the cost of manufacture.

Improvement of Cordite manufacture enabled many of the Kenvil buildings to be diverted to the manufacture of Pyro rifle powders. Additional machinery was installed with contracts to supply this Pyro powder to both the Russian and British governments. The last Cordite contract was completed in July 1917 and about that time, with the United States entering the war, the demand for Pyro powder had increased tremendously. Work was begun to convert all Cordite lines to manufacture Pyro powder, although Hercules concentrated mostly on Pyro powder for field cannon. In addition to cannon powder, however, Hercules produced during the war nearly 3,000,000 pounds of small-arms powder of double-base, progressive and Pyro types for military purposes. Its efforts, headed by a development by H. H. Champney, enabled the Government to replace black ignition powder with a smokeless type for use as an ignition charge for cannon powder.

During the World War Hercules turned out over 100,000,000 pounds of military smokeless powder. This is decidedly interesting, since the production was by a company which had never made any cannon powder and by one whose sporting powder experience was hardly a year old when the war started. Its entire technical staff who had manufactured smokeless powder before, including those from the Union Company which they absorbed, numbered less than a dozen. The records indicate that it produced 46,000,000 pounds of Cordite, 3,000,000 pounds of small-arms powders, and 54,000,000 pounds of nitrocellulose cannon powder.

XVII

MANUFACTURE AND USE OF BULK, SINGLE-BASE, AND DOUBLE-BASE POWDERS

WHEN Gladys Hasty Carroll wrote her famous book, *The World Changes,* she didn't have the handloading of small-arms ammunition in mind; it is quite doubtful, indeed, that she ever thought seriously of this subject, and yet the title of her book applies most aptly to the handloading field.

The world does change—it moves on! Recent smokeless powders are far more effective than those available a scant five years ago. Present developments still in the process of experimentation show greater promise than even those now available. With the coming of new powders, older ones have been made obsolete. The Hercules Powder Company still manufactures the majority of its old-line powders and has done little "discontinuing" in the twenty-five years since its formation. On the other hand, Du Pont has released and discontinued countless powders. Of the entire Du Pont line manufactured at the close of the First World War, *not one* type is being made in the post-World War II era.

When does a powder become obsolete? The answer is very simple: When it is no longer available, or when it is destroyed through decomposition. Modern powders do not decompose. Many of those made at the beginning of smokeless powder development are still in perfect condition. True, others have been abandoned because of a tendency to decompose, but the major reason for the discontinuance of powders is not that the makers find the powder to be unsatisfactory, but that *they have developed something better!* A powder, therefore, is actually "obsolete" when one can no longer obtain it, and despite the fact that many of the Du Pont powders were discontinued from a manufacturing standpoint many long years ago, they are still available through various sources. Supply magazines may have a quantity of discontinued items on hand, dealers' stocks are quite likely to have the desired number, and the private unused stocks of reloaders very frequently have an excess supply which is disposed of among the reloading clan through the time-honored method of "trading."

Types of Smokeless Powder. Before describing the use of various smokeless powders, it is well to have a broad understanding of their method of manufacture, which will give an excellent insight into the limitations of each type of propellent. Formerly two types of powders were manufactured—referring, of course, solely to powders developed for use in rifled arms, either handgun or shoulder weapon—bulk and dense.

The dense powder is, in turn, subdivided into three distinct classes: straight nitrocellulose such as the IMR series; double-base powders composed of nitroglycerine and nitrocellulose, of which HiVel, Unique, Sharpshooter, etc., are outstanding examples; and the new Du Pont type of multibase, similar to the double-base but containing additional ingredients. Du Pont Pistol #6, first used by the writer in 1933, but not released for canister sale until the summer of 1935, is an outstanding example of this.

Dense powders are formed into hard grains—grains which cannot be crushed with the fingers. Bulk powders are extremely friable. In other words, if a few grains are rubbed together in the hand, they partially pulverize. Dense powders are further controlled in burning by coating them with various ingredients, among them being DNT (dinitrotoluol) and Centralite as the most common. This coating slows down the action of the initial ignition of the primer on the powder. The grains burn extremely slowly until this coating has been "eaten off," whereupon they speed up rapidly. By the time the coating has gone, the bullet has progressed a fraction of an inch into the rifling from the mouth of the shell and thus is already in motion when the "big push" is given it. Also, this initial start and the consequent holding up of the pressure due to the slower rate of burning, creates a greater muzzle pressure than that of uncoated powders, and the acceleration of the bullet continues throughout the length of the barrel.

Progressive-burning powder first appeared in the Du Pont line around 1915, replacing the Military Rifle series then known as "MR Powder." The new progressive-burning types were labeled "Improved Military Rifle Powder" (IMR), which designation they retain to date.

All smokeless rifle powder commences life as straight nitrocellulose. This is a material obtained

by nitrating cellulose (vegetable fiber) in a mixture of nitric and sulphuric acids. The result is guncotton, described in a previous chapter. Most of our nitrocellulose used for smokeless powder throughout the past quarter-century has had a nitrogen content of between 12.5 and 12.7%. It is about 95% soluble in a mixture of 2 parts of ether and one of ethyl alcohol. Nitrocellulose of this type in past years has often been called "Pyrocellulose," a coined word intended chiefly for the use of the powder-manufacturing industry. On the other hand, guncotton, as generally known among the explosives makers, is a *particular* form of nitrocellulose having between 13 and 13.4% nitrogen and only partially soluble in the above ether-alcohol mixture.

Methods of Manufacture. Most powder factories begin the process of manufacture by compounding their own nitric and sulphuric acids. At the same time they maintain an expensive reclamation department, which need not be discussed here; its sole purpose is that of recovering and utilizing acids and other by-products in the manufacture of powder. The basic material consists of bales of a crude cotton of the grade known as "linters." This is usually a short fiber. The longer types are used in the manufacture of textiles. The cotton is freed from all traces of oil by being "boiled" for several hours in a caustic soda solution. The nitric and sulphuric acids are then mixed, all steps in the process being covered by numerous laboratory examinations of small batches. The acids are added to the cotton fibers and thoroughly stirred, the process being controlled at a very even temperature throughout the digesting. The mixing machines, generally known as "nitrators," thoroughly stir and blend the acid pulp, and the process turns the cotton fiber into "nitrate of cellulose," which has been shortened to the more expressive word "nitrocellulose." Water is formed by the action of the nitric acid, and this water is absorbed by the sulphuric acid, preventing the chemical action of hydrolysis which would otherwise result. The pulp is then freed of excess acid by whirling for some time in centrifugal wringers. In the early stages of manufacture this weakened acid was discarded as waste. Today it is all salvaged and remanufactured to remove unwanted materials.

As soon as the pulpy mass is removed from the wringer it is immediately immersed in water to wash away as much as possible of the remaining acids. If permitted to stand, even for a short time, it would catch fire from spontaneous combustion. The nitrocellulose is boiled for approximately forty-eight hours in water to free it from acid. Even in this stage of the process, frequent laboratory tests must be resorted to, as the water must contain a certain amount of acid in its initial boiling stages. Otherwise, the nitrocellulose will not be uniform in strength.

After this washing process has been completed, the sludgy mass of nitrated cotton fibers is reduced to a pulp by a beating machine very similar to that used in the manufacture of paper. Again the laboratory checks samples from each beater at frequent intervals to make sure that the pulping process results in a uniform texture of the mixture. The pulp is then transferred to large wooden tubs where a further boiling treatment is given, while at the same time agitators keep the mass constantly stirred to set free any acids imprisoned inside of the individual fibers. This process consists of from five to seven separate washings, each for a period of not less than five hours, the mixture being kept at the boiling point all the time. It is then washed a dozen times with a change of water in each washing, and further chemical tests are made to determine nitrogen content, solubility, stability, freedom from acids, and quality. The nitrocellulose is then complete and ready to be turned into smokeless powder.

Bulk powder is manufactured in a form of "still" containing an agitator. To the wet mass of pulp is added a solution of barium and potassium nitrates, its proportions depending upon the chemical formula of the individual powder. With the mass being constantly stirred, a solvent is added, also more or less of a manufacturing secret depending upon the patent specifications of the powder, but usually consisting of a mixture of amyl acetate, benzol, and a small quantity of paraffin oil. This solvent is not soluble in water and separates into tiny globules with the stirring. Each globule dissolves a certain amount of nitrocellulose, depending entirely upon its contact; hence the necessity for the agitators or stirrers. The various globules meet and combine with each other only to be broken up constantly by the agitator blades, thus insuring an even chemical blend. After a certain period of stirring, heat is applied and the solvent is boiled off, the evaporation leaving hard grains of nitrocellulose in the water. Hence Du Pont's 1935 series of advertisements "Du Pont powders are born under water." Du Pont originated this process under the direction of the late Francis G. du Pont. Thus was the famous Du Pont bulk shotgun powder manufactured.

[Special Note: Description following applies to manufacture in the 1930's. Chapter II of the attached supplement gives the current methods.]

In the manufacture of double- and single-base powders wet nitrocellulose is dehydrated or freed from its water content by forcing alcohol through it under pressure, the latter displacing the water. This process is conducted in a heavy hydraulic press, and the nitrocellulose in cake form eventually contains only a small quantity of the original alcohol, owing to its compression. Francis du Pont also invented this system, although similar applications were brought out in foreign countries at about the same time. The Du Pont dehydration process, now practically universally used, eliminated most of the danger from the manufacture of smokeless powder, also eliminating the necessity of air-drying nitrocellulose—a dangerous process often resulting in serious fires due to spontaneous combustion.

The plastic cake of nitrocellulose and alcohol is then entered into a large mixing machine, and amyl acetate or acetone is added to dissolve the fibers. At this stage, nitroglycerine, a liquid, is added, and extreme care must be taken, as the resultant mixture, known among the boys as "soup," is rather touchy stuff to handle. It is wheeled around in small tank trucks having enormous pneumatic-tired wheels. One has a very peculiar sensation, standing in a powder plant, when an experienced workman wheels his little cart by you nonchalantly but by no means *carelessly*. Accidents *do* occur, but these workmen bear in mind that an accident can only happen to them *once* and realize that they never have an opportunity to correct a mistake. This explosive mass, after being thoroughly mixed until it becomes plastic, is transferred to a special hydraulic press and made to pass through dies which give it the desired form of tubes or perforated cylinders. Both Du Pont and Aspinwall devised the idea of perforated powder grains to control burning at approximately the same time.

Edward Ancrum Whistler Everett, nephew of Col. G. N. Whistler, co-inventor of "W. A." powder, personally made the first die for the extrusion of a perforated powder. This was built of agate or bloodstone. In modern days the mass is pressed through a die holder having a multitude of dies, each, of course, containing a center which forms the perforation of the grain. These long strings of powder, although plastic, have a certain resiliency, and, guarded by experienced workmen, are permitted to coil into long ropes. The strands, in turn, are fed through special rollers which handle the strings without mashing, and whirling knives clip them into short grains as they protrude through the opposite end of the cutting machine. The latter machine, of an adjustable nature, controls to a remarkably uniform degree the exact length of the finished powder grain. Following this cutting process comes the drying, sieving and blending. The latter is done in several ways. Large bags of powder are emptied into a drum, together with a small quantity of graphite, and tumbled at length. This polishes the grains and removes irregular projections which may have been caused by the cutting or trimming process. Following this, the powder is again shoveled into barrels, hoisted to a large platform, and from there poured into bins. These bins are again cleared of powder by shoveling into other barrels, and the pouring continues, thus insuring proper blending of different batches.

Nitrocellulose powders are started in much the same manner as the nitroglycerine types and carry through the dehydration process exactly the same. Following this it is placed in a mixture with ether, diphenylamine, graphite and other secret ingredients. In later years, the use of diphenylamine as a solvent has been abandoned. Following this mixing, the mass is shifted to a hydraulic press and squeezed into a cylinder about a foot in diameter and 18 inches long. These cakes, still in plastic state, are inserted in the final hydraulic press and extruded through dies in the same manner as that described for the so-called "double-base powder." The nitrocellulose powder, however, still contains an enormous amount of the ether used as a solvent, and since this is too valuable to waste, the granulated powder is sent to the solvent recovery room, where the ether is gasified by a current of warm air circulating through it. This ether-bearing atmosphere is then run through refrigerator pipes condensing the ether for future re-use. This solvent recovery was also a Du Pont process, and it not only saves an enormous amount of money in the course of a year's manufacture, but also has a great deal to do with the uniformity of the final batch.

The "solvent recovery room," however, has been unable to remove all ether from the powder, and here again water is employed, the powder being put into warm water for from one to two weeks. This process is known as "water drying." A current of warm air then removes the water, whereupon the grains are glazed, coated if necessary, sieved, blended, and placed in storage. Coating of either single- or double-base powders is invariably done before the graphite glazing process.

Incidentally, certain so-called "authorities" have claimed that double-base or nitroglycerine powders were not of the progressive burning variety, and

that the grains were never coated with any ingredient other than graphite. This is not true! Today, practically the entire line of American nitroglycerine powders has its grain structure coated on a secret formula to control its rate of burning. Thus has nitroglycerine powder development kept pace with that of the nitrocellulose types in the IMR class.

In the manufacture of the broken-grain types of the so-called "multi-base" types, such as Du Pont MX Progressive Shotgun, Du Pont Pistol #6—an offshoot of MX—and other such powders, the grains are formed by a granulating process instead of by extrusion through dies. Other than this, manufacture is essentially the same as that of other gelatinized powders. "Multi-base" powders in addition to containing nitroglycerine also contain several other active ingredients plus another "secret" ingredient which serves as a stabilizer and therefore contributes to its useful life. According to Du Pont, this type of powder is superior to either single-base or double-base forms, burning cleanly; is non-hygroscopic; has equibalanced ignition, plus balance and uniformly even recoil. In a powder of this sort the peak of the working pressure is reached in .0005 to .0008 seconds. Du Pont further claims that the pressure curve rises more evenly, thus accounting for uniformity.

In discussing this powder, Wallace H. Coxe, Du Pont's ballistic engineer, told the author: "Smokeless powders do not burn instantaneously, but the burning takes place successively from grain to grain. This means, of course, that the first grains coming into contact with the flame of the primer or the flying priming particles thrown off by the hammer blow, ignite the powder grains with which they come in contact. These, in turn, ignite others nearest them, and so on."

Not only because of its formula but also because of the type of granulation, Mr. Coxe claims that these multi-base powders ignite very readily and communicate the ignition easily and unhesitatingly throughout the entire charge, thus transforming the powder grains into gaseous products with a steadily increasing pressure. This means a conservation of heat, and where there is a loss of heat in ignition there is a loss of energy and efficiency. Du Pont Pistol #6 is of similar formula to MX Shotgun, but owing to its different usage in short-barrel pistol cartridges, it is designed to burn more rapidly.

Use of Powders in Handloading. Smokeless powders are greatly misunderstood in action even by the experienced handloader. Their rapidity of burning is very definitely controlled by the pressure developed. In other words, if 50 grains of a certain powder are used in a Springfield rifle case behind a 172-grain bullet, a pressure of, let us say, 50,000 pounds will be developed. The powder will burn at a rate which can be mathematically predetermined by a student of *interior* ballistics. On the other hand, the same charge of powder in a Springfield cartridge case necked down to .22 caliber, all other dimensions being the same, will burn more rapidly with a tremendously high pressure, possibly double; in other words, in the vicinity of 100,000 pounds. The result is an explosion which wrecks the gun. This is considered, even with the light-weight bullet such as the 45-grain Hornet, due to a lack of balance between case shape and weight of powder. The small hole known as the bore prevents the escape of these gases, whereupon complete combustion occurs in a much shorter time, raising the pressures beyond the safety limit of both action and shell case.

The shape of the shell also has much to do with combustion. Certain powders burning at a predetermined and proper rate of speed in a long straight taper case will burn with dangerous pressures in a bottle-neck type, primarily because of a churning action of the powder gases while the powder is burning. It is for this reason that different powders have been developed. It is for this reason, too, that the handloader will employ *several* different types of powder when using various bullets at assorted velocities *even in the same rifle.* Ammunition factories have excellent laboratories at their disposal. They have an assortment of available powders which are tested in their own laboratories, and proper loadings have been developed. Hence they emit loud wails, claiming that the reloader cannot duplicate the quality of their product even when using their components because he lacks the necessary facilities for laboratory testing of ammunition.

This wail might be justified were it not for the fact that the complaint is entirely illogical. True, we chaps who concoct all sorts of special target and hunting loads are rarely equipped with chronographs, pressure guns and equipment necessary to the development of freak ideas. We do not need them. Du Pont maintains the excellent Burnside Laboratory and Hercules the fully equipped Experimental Station. Once these laboratories developed tested loads for the handloader. This has been discontinued, but they still test lots released to the boys. Thus canister powders are of uniform quality. Many batches are tested for uniformity and the most of them rejected for canister trade. Selected groups of finest quality of

powders meeting very rigid specifications are set aside as "canister grades." The author has frequently heard comment to the effect that handloading is not satisfactory because only the *poorest* of powders which could not be sold to ammunition factories are assigned to canisters to be sold to unsuspecting handloaders. This is entirely untrue. No other powder tests are as rigid as those given the powders sold in canister lots for handloading. These powders are always uniform. The lots not measuring up to these rigid specifications are set aside for sale *to ammunition factories.*

This, also, is far from being a hardship. The makers of ammunition have excellently equipped laboratories to devote to testing. Thus a powder designed for one class of cartridge, if failing to meet canister specifications, may be diverted to an entirely different class of cartridges, if it performs properly. All components differ to a considerable extent, particularly primers. One maker may find that, with his particular components, a powder unsuited for sale to handloaders can be made to perform perfectly within his factory.

Handloaded ammunition, with the particular grades of tested canister powders, is by no means "a shot in the dark." There is no reason why the home loader should not know exactly what he is doing. Du Pont and Hercules are continually testing these special canister powders. You can be sure that all lots you may buy have the same ballistic characteristics, thereby eliminating any guess-work on your part if you as a handloader are careful to abide by the recommendations and warnings. A good handloader's product is more inclined to be uniform than that of the ammunition manufacturer because of his being more or less his own laboratory; every handloaded cartridge is assembled entirely by himself, whereas in factories an assortment of machines do the work, with sample batches withdrawn from these machines at regular intervals for laboratory inspection.

Examination of the loading data in this book will at first belie the truth of the author's statement that different powders are required for different purposes. Modern smokeless powder has been greatly improved in recent years. Laboratory tests have shown them to be far more flexible than the powders of yore. This is one of the major reasons for the discontinuance of the older types of powders.

One question which will arise in the mind of the reloader is the advisability of using double-base or nitroglycerine powders. The general characteristics of these powders are such that they ignite more easily and burn at a greater temperature than those of the pure nitrocellulose group. The tremendous heat thus liberated, even though over a very short period of time, causes a burning or melting of the surface of the lands at the breech of the barrel. This burnt surface, although very minor, is washed away with each succeeding shot, resulting in what is technically known as erosion.

A test has been made to determine the heat of the explosion of smokeless powders. Some seven years ago the British Government tested a number of powders and found that their old Cordite Mark I developed 1114 gram calories per gram. Modified Cordite (MD) developed 939. Cordite RDB developed 904, while Du Pont IMR 16 (now obsolete) developed 815. Tests, however, have proved that the potential power, heat, energy, or whatever you may choose to call it, of any smokeless powder, is only *partially* used in propelling the bullet. One-third is blown out of the muzzle, one-third is used to heat the barrel, and only one-third is actually applied to the propulsion of the bullet.

Definite tests show that there is a tremendous waste of energy developed by the powder charge. The British Ordnance Department made numerous tests along these lines. This is reported in detail by Major Hardcastle in the *Royal Artillery Journal* of October 1918 in which he says:

"The charge is 37.5 grains of MD Cordite (tubular). Each grain contains 195 foot-pounds of energy, so that the total energy developed by the charge is 7320 foot-pounds. The bullet weighs 174 grains and its muzzle velocity is 2440 f.s., so that the bullet has a muzzle energy of 2300 foot-pounds, leaving 5020 foot-pounds to be accounted for. . . .

"The following facts have been observed:

"Allowing a small amount for loss of heat in radiation, it takes 600 rounds to bring the water in the Maxim jacket to the boiling point. The capacity of the Maxim jacket is about 7.7 pints or 8.8 pounds of water. The weight of the brass and iron in the barrel and jacket is about 20 pounds, counting as 2 pounds of water for an equal rise in temperature. So that about 11 pounds of water have to be raised from 60° F. to 212° F. by 600 rounds. It requires 777 foot-pounds of energy to raise 1 pound of water 1° F., so that each round puts 2140 foot-pounds of energy into the water jacket. . . .

"The energy of the powder gas as the bullet leaves the muzzle is about that due to half the charge and the whole muzzle velocity—say 254 foot-pounds. . . .

"A Mark VII bullet with a small hole bored near the base in the envelope frequently sprays out

molten lead as it flies. From this fact it has been calculated that the heating of the bullet absorbs 260 foot-pounds, the 40 grains of the cupro-nickel envelope being heated to 550° F. As this 260 foot-pounds is produced in the bullet by friction, it is only right to suppose that the barrel is heated by friction to a like quantity of 260 foot-pounds. . . .

"The energy of rotation of the bullet accounts for 35 pounds. The heat of the ejected cartridge case accounts for 5 foot-pounds. . . . This leaves 2315 foot-pounds to be accounted for in the energy of the muzzle blast."

The total energy per grain of this powder was obtained by immersing a vessel capable of holding 1000 grains of water in a water bath before firing, and leaving it there to cool. By actually exploding powder at a known density of loading in a closed vessel and observing its maximum pressure, the force can be obtained by calculation. The total energy is obtained by immersing that closed vessel in a water bath, then observing the rise of temperature of the water bath to determine the heat evolved by firing.

Nitroglycerine powders, however, particularly as made in America, produce very excellent results in the form of accuracy at a given velocity and pressure. That they have been more destructive to barrels has long been an accepted fact, and yet, as time progresses, this once-truth may even be abandoned as a downright falsehood. Under date of July 18, 1933, following a lengthy discussion with L. C. Weldin, ballistic engineer of the Hercules Powder Company, he wrote me as follows:

"This question of erosion in rifles you have brought up has either been misrepresented or misunderstood. The advent of the new non-corrosive type of primer has proven that the barrel erosion formerly attributed to the powder was *due to the priming mixture.* Before the Government used HiVel powder in National Match ammunition for use at Camp Perry, they made a complete and comprehensive test of these two types of powder loaded to full service velocity. Their results indicate that there is only a matter of 200 or 300 rounds difference in the accuracy life of the rifle between the two types of powders. It is perfectly true that for a unit weight of each type of powder the nitroglycerine grade gives a greater potential energy and more heat than that of the nitrocellulose powder. However, one uses *less* of the nitroglycerine powder for the same velocity and develops lower pressures. This feature largely offsets the difference in temperature. For example, in the .30/06 Springfield, our HiVel #2 requiring a charge of 45.3 grains gives the same velocity as 49.5 grains of the service propellent (IMR #1185, a nitrocellulose powder) The maximum theoretical temperatures calculated for straight nitrocellulose powder per unit weight is 3000° C. The corresponding figure for HiVel is 3100° C."

Since the average reloader today will bend his efforts along the lines of using non-corrosive types of primers, he need not fear any damage to his pet barrel through the use of nitroglycerine types of powders, particularly if he stays away from all loads closely approaching the maximum.

Thus is another popular fallacy shattered. Today the author would not hesitate to use modern nitroglycerine powders with non-corrosive primers in his particular rifle. As a matter of fact he uses nine different types of nitroglycerine or double-base powders in his handloading and puts them through some of his hand-made barrels with no more fear or concern than he would straight nitrocellulose types.

XVIII

SMOKELESS POWDERS FOR THE HANDLOADER

BULK powders, of course, were invented and used before the introduction of dense smokeless types. A long chain of these was available at the beginning of the twentieth century. Today, Du Pont Sporting Rifle #80 is the only survivor among rifle powders. However, since a great many powders listed as "obsolete" are still available to the reloader, they will be described in detail.

Du Pont #1 Rifle Smokeless. Introduced 1894. Discontinued 1926. This was the first satisfactory smokeless powder and was intended for scoop measuring instead of weighing. No. 1 Rifle powder was a pale grayish-yellow in color, of irregular granulation, and was sifted through a wire mesh 16 to the inch and caught on screens 26 to the inch. It was intended for low pressures and used in such cartridges as the Winchester .22 Single Shot, .22/15 and .22/16 Stevens, .25/20 Repeater and Single Shot, .25/25 Stevens, .32/20 Winchester, .32/40 Winchester, Marlin and Ballard, .38/55 ditto and .38/56. That it was reasonably flexible is ascertained by the analysis of the above classes which have been copied from a canister of Du Pont #1 in the writer's possession. The .22 Winchester Single Shot was a cartridge similar to the Hornet. In fact, the Hornet was manufactured first using the original Winchester shells. The .38/56 was a large-capacity bottle-neck shell. The .38/55 and .32/40 were large-capacity straight-taper shells. The .22 Winchester Single Shot used a 45-grain lead bullet. The .38/56 used a 255-grain lead bullet. Du Pont #1 was also used widely in special target rifles in which the bullet was seated into the rifle by hand, either from the breech or by means of the Pope false muzzle in which the bullet was run into the barrel base first by means of a special muzzle starter and ramrod and a false muzzle on the barrel. The powder was loaded usually at the firing point in the form of a "blank" cartridge, a wad being used to retain the powder in the shell. This powder is ideal for loading in old-time cartridges if you are fortunate enough to obtain any of it.

No. 1 is inclined to crumble under the pressure of the bullet, therefore for best results it should be used *within a few days of loading.* Do not store cartridges loaded with this powder for any appreciable length of time, as the crumbling will produce high pressures. It is extremely hygroscopic and should be kept away from all dampness. This was one of the major reasons for its discontinuance. This powder is designed to operate at pressures between 20,000 and 25,000 pounds.

There was an additional powder, however, also known as Du Pont #1, quite possibly incorrectly so. A powder of which very little additional data can be ascertained was known as .30-Caliber Military by Du Pont and by the Army as Du Pont #1. The commanding officer, Frankford Arsenal, reports under date of August 13, 1935, reference FA 471.83/285-6, "In 1895, a contract was let to the Du Pont Company for 2500 pounds of Du Pont #1 and 1000 pounds was delivered on July 10 of that year. A thousand and an additional 500 were delivered on November 29, 1895. This Du Pont #1 is probably the powder you refer to. It was a cylindrical-shaped grain in contrast to the sandlike particles of the other powders. The diameter was .050 and the length .054 to .064. It was a green-colored powder with yellow spots, hard and tough. In the caliber .30 (Krag) using 36 grains as a charge, it gave 1952 f.s. velocity and 32,600 pounds pressure. Model 1898 Krag was given ammunition loaded with all three of these powders (Peyton, W.A., and Du Pont #1). This powder is rare today, and it is doubtful whether any of it will turn up; but if it should, do not confuse it with what is generally known as Du Pont #1—a bulk smokeless powder.

Du Pont Smokeless Rifle #2. Introduced 1894. Discontinued 1926 (?). This powder was identical with Smokeless Rifle #1 except for granulation. It was somewhat finer than #1 and was thus intended primarily for cartridges used both in rifles and revolvers interchangeably. A Du Pont booklet published in 1903 gave the following loading data: .45/35/255 Colt, 10 grs.; .44/23/255 Russian, 7 grs.; .44/40/200 Winchester & Colt, 17 grs.; .41 Long Colt, 6 grs.; .38/40/180 Winchester & Colt, 16 grs.; .38 Army (Long Colt) 5 grs.; 38 S. & W., 4.5 grs.; .32 Long Colt, 4 grs.; .32 S. & W., 3 grs. No velocities were given, but because of the nature of the powder it may be assumed that these charges rep-

resented the standard black powder ballistics of that period.

Because of the nature of this powder and the fact that it is of very soft grain, it will need to be carefully screened and freed of dust before being used for handloading. The dust, particularly in revolver cartridges, can leak into the primer pockets, thus blowing out primers, and in every case will seriously raise pressures. If you happen to have a few canisters of Du Pont Rifle Smokeless #2, and they appear to be in good condition, by all means use this powder, but do not permit it to remain in loaded cartridges for more than a few days before firing. It crumbles badly.

Du Pont Schuetzen. Introduced 1908. Discontinued 1923. Burning pressure 22,000 to 26,000 pounds. This is a true bulk-for-bulk smokeless rifle powder. In other words, charge cups for black powder can be used for an equal charge of Schuetzen the same as in Du Pont #1. It is, of course, straight nitrocellulose, large grains of light red or pale orange, irregular in shape. The grains pass through a screen having a mesh of 15 to the inch and are caught on a screen 25 to the inch. Schuetzen was designed for target shooting in the famous Schuetzen rifles, mostly .32/40 or .38/55, although it has been used in various smaller bores such as .25/20 Single Shot. It was long considered the most accurate smokeless powder ever manufactured, but was discontinued with the advent of improved powder less hygroscopic. It may be found available to a great many handloaders, and if so it will prove to be thoroughly efficient in its work, despite the years which have elapsed since its manufacture. Cartridges loaded with Schuetzen, like those loaded with #1, should not be stored any great length of time.

The history of Schuetzen Smokeless is decidedly interesting. This was nothing more nor less than #1 Rifle Smokeless to which a coloring ingredient had been added and such slight change incorporated as would be necessitated in the rumbling process necessary to give it the pale orange color. Schuetzen was born through the fact that one of our large ammunition companies, which had previously purchased several thousand pounds of #1 Rifle Smokeless each year, suddenly switched to the use of some of the more modern dense smokeless powders. The Du Pont factory was left with a lot of some 40,000 pounds of a bulk rifle powder on its hands for which there was obviously no further market among commercial manufacturers. Major K. K. V. Casey, genius in charge of the Military Sales Division, suggested certain changes, so Du Pont worked over the entire lot, changing its color, slightly lowering its rate of burning, whereupon it was packed in a supply of the old Laflin & Rand Orange Black rifle-powder canisters which were on hand, and a new label applied.

The use of old black powder was fast going into discard by handloaders, so Du Pont offered the owners of these old rifles a truly smokeless powder, a canister of which would load the same number of rounds as had their previous pound of black powder. Schuetzen was priced at that time at only 50 cents a canister, while black powder was selling for about 40 cents a pound. It was a highly desirable powder for the handloader who had the old-style black-powder rifles, and even today if properly handled it makes a very accurate load. In a recent loading using cast bullets in a Hornet at a velocity of around 1500 f.s. the author shot several 50-yard groups, some of which ran as small as ⅝ of an inch. No group in the entire fifty shots ran over one inch.

Du Pont Bulk Shotgun. Introduced 1893. Still Manufactured 1948. One of the first successful smokeless powders in shotguns. Not a true bulk-for-bulk but closely approaching it. Quite hygroscopic but extremely successful in its field. In shot shells it was for many years the favorite with trap shooters because of its smooth recoil, even after more ballistically satisfactory shotgun powders had been developed. The recoil was easier on the shoulder than that developed by the dense powders exemplified in Infallible and Ballistite. It was designed to burn at around 9000 pounds pressure and riflemen soon learned that it could be used in a variety of cartridges of many types, particularly for reduced loads much along the lines of the Schuetzen and Rifle Smokeless #1. It can be used in the Springfield for gallery charges, and when loads are properly developed the accuracy is equal to that obtained with #75 and #80. It is coarse in granulation and quite friable. The reloader should sift it carefully on a very fine screen or agitate it in a very shallow dish while blowing gently on it to remove dust. It can be used in revolvers for indoor gallery loads and light charges, particularly with round balls. In this case the best performance is obtained with it when the lead balls are seated deeply in the cartridge case to compress the powder. This means using a straight case.

Du Pont Schultz Shotgun. Introduced Before 1900. Discontinued 1926. Schultz was another member of the Du Pont bulk shotgun family very similar to Bulk Shotgun. It has very clean, irregular egg-shaped granulation of a soft creamy-white color. Although designed for use in shotguns, it has been used by many handloaders with

reasonable success for very light gallery charges, particularly with round balls both in rifle and handgun cartridges. In using it for this purpose the handloader must take extreme care, as with other bulk powders, freeing it from dust and loading it with round balls in very light charges, gradually building up until accuracy is obtained. This powder, similar to other bulk shotgun types, will build excessive head pressures in metallic cartridges, and primers should be watched very carefully for indication of overloads.

Du Pont Empire Shotgun. Introduced 1908 (?). Discontinued About 1914. Empire is a bulk smokeless shotgun powder originally designed by Curtis & Harvey of the Nobel-Du Pont organization in England. Its formula with smooth, spherical purple grains is essentially pure nitrocellulose containing barium or other metallic nitrates with small percentage of a nitrating agent. It was for many years extremely popular with handloaders of shotguns and can be used for light loads in rifles much the same as E. C. and Smokeless Shotgun.

Hercules E. C. Powder. Introduced About 1894. Discontinued 1931. This powder is very similar in characteristics to Bulk Shotgun, although slightly finer in granulation and colored a soft orange. It is bulk and of soft granulation, and while not designed for use in revolvers and rifles, it performs excellently in reduced loads, particularly with cast bullets. It was also manufactured by Du Pont previous to the formation of Hercules.

Du Pont Gallery Rifle #75. Introduced 1904. Discontinued 1928. For many years this powder was marketed under the name of "Marksman." Its discontinuance left serious regrets among the reloaders, as it was long one of our most important rifle powders. A friend of mine, who, like me, many years ago used it widely in reloading, was so firmly "sold" on its performance that he has for the past few years been scouring the country and picking up canisters of it here and there, wherever he could locate them in his travels. Old-timers will readily recall the excellence of the "Marksman." The most recent addict to handloading will know it only as "#75." It is a bulk powder, although by no means the true bulk-for-bulk type. It is considerably more concentrated and less hygroscopic than its predecessors, fine-grained, fibrous in structure, irregular in size and shape, and in the manufacturing was polished or tumbled so that all irregular corners were worn from the grains to make the powder flow freely in measures. It is for this latter reason that it proved so popular in the early days.

This steel-color or soft gray powder has a wider range of grain size, having been screened through a 26-to-the-inch mesh and caught on a 60 mesh. It was designed for use in the Krag rifle in reduced charges even while the Government was experimenting with the then recently adopted Model 1903 cartridge. Its purpose of development was strictly to give a military reduced or target load suitable for ranges up to 200 yards. Although it is generally known as a Du Pont powder, it was designed and originally manufactured by Laflin & Rand, and was intended, of course, for a cast bullet rather than the jacketed variety.

The early "Marksman" powder proved exceptionally accurate in various cartridges such as .25/20, .25/35, .25/36, .30/30, and .32/40 and even in the Model 1906. It has been widely used in practically every military rifle cartridge for which handloading has been done in this country. In the smaller cartridges it develops "standard" results. In the larger cartridges it is better adapted to mid-range or low-power loadings. Burning pressure, due to its fine granulation, was designed for between 10,000 and 15,000 pounds, although it will perform excellently at from 7500 to 22,000.

A load the writer used many years ago in the Krag, using Ideal bullet #308403 designed by Harry Pope, included a charge of 11 grains giving a velocity with this 172-grain multiple-diameter bullet in the vicinity of 1200 f.s. With 150-grain Service bullets obtained shortly after the World War, and used in the .30/06, I ran from 13 to 18 grains of #75, the latter developing in the vicinity of 1800 f.s.; and accuracy was equal to any loads I have put together in recent years. No. 75 was the quickest-burning of the bulk powders on the market, and was designed for use with cast bullets of the plain-base variety, since it did not fuse the bases as much as the modern types. It burns excellently even when a small charge is put into a large shell. As with other bulk powders, loaded ammunition should be used within a short time, as, owing to the condition of the shells caused by previous firings, #75 is inclined to deteriorate partially, burn erratically, and therefore lose its accuracy. If you can obtain any of this powder you will find it excellent for reloading purposes in practically any modern or semi-modern cartridge case.

The author's notes indicate that around 1903 the various National Guard outfits in New York City commenced reloading their .30/40 cartridges for use on their splendid 100-yard indoor galleries. Ed Taylor, inspector of the Laflin & Rand Powder Company, became interested in the shooting of the guardsmen, as he was an active friend of all riflemen. The result was that the Laflin & Rand out-

fit prepared a new bulk smokeless powder by taking the fine screenings of new E. C. or Schuetzen powder, reworking them, blending, coloring them the characteristic yellowish-gray, and marketing the powder to the guardsmen under the title of "Marksman." It rapidly became so popular that in time the demand exceeded the supply of screenings, and some commercial lots were manufactured to keep pace with the call for it. When absorbed by Du Pont, this powder was manufactured for some years under the title of "Marksman" and later, shortly before Sporting Rifle #80 was brought out, Du Pont changed the title to "Gallery Rifle #75." It is an excellent powder, but there is no reason for regretting its passing, as #80 will do everything that is claimed for #75.

Du Pont Sporting Rifle #80. Introduced in 1913. Discontinued 1939. No. 80 is the only remaining American rifle powder in the so-called "bulk" class, although it is by no means a true bulk-for-bulk powder in which equal bulk charges of black and smokeless are used. No. 80, generally known as "Sporting Rifle #80," is essentially, in fact *exactly*, what its name implies—a *rifle* powder. It is, however, well adapted to certain handgun loads if not used to obtain too great a velocity. The grains are fibrous, buff colored, irregular in shape as are all so-called "bulk" powders, and vary in size, the powders dropping through a screen of 24-to-the-inch mesh and caught on 56 mesh. When #80 was produced—at the time the World War started—it was designed for use in the now old-fashioned low-power types used with both black and smokeless powder. It works excellently, however, throughout the chain of modern sporting rifles as a mid-range load with plain lead, gas-check, and metal-jacketed bullets. It can be used in revolver, automatic pistol, and automatic rifle cartridges, and in high-power rifles for mid-range loads of superb accuracy in everything from the .22 Savage Hi-Power and .25 Remington up through to the .405 Winchester.

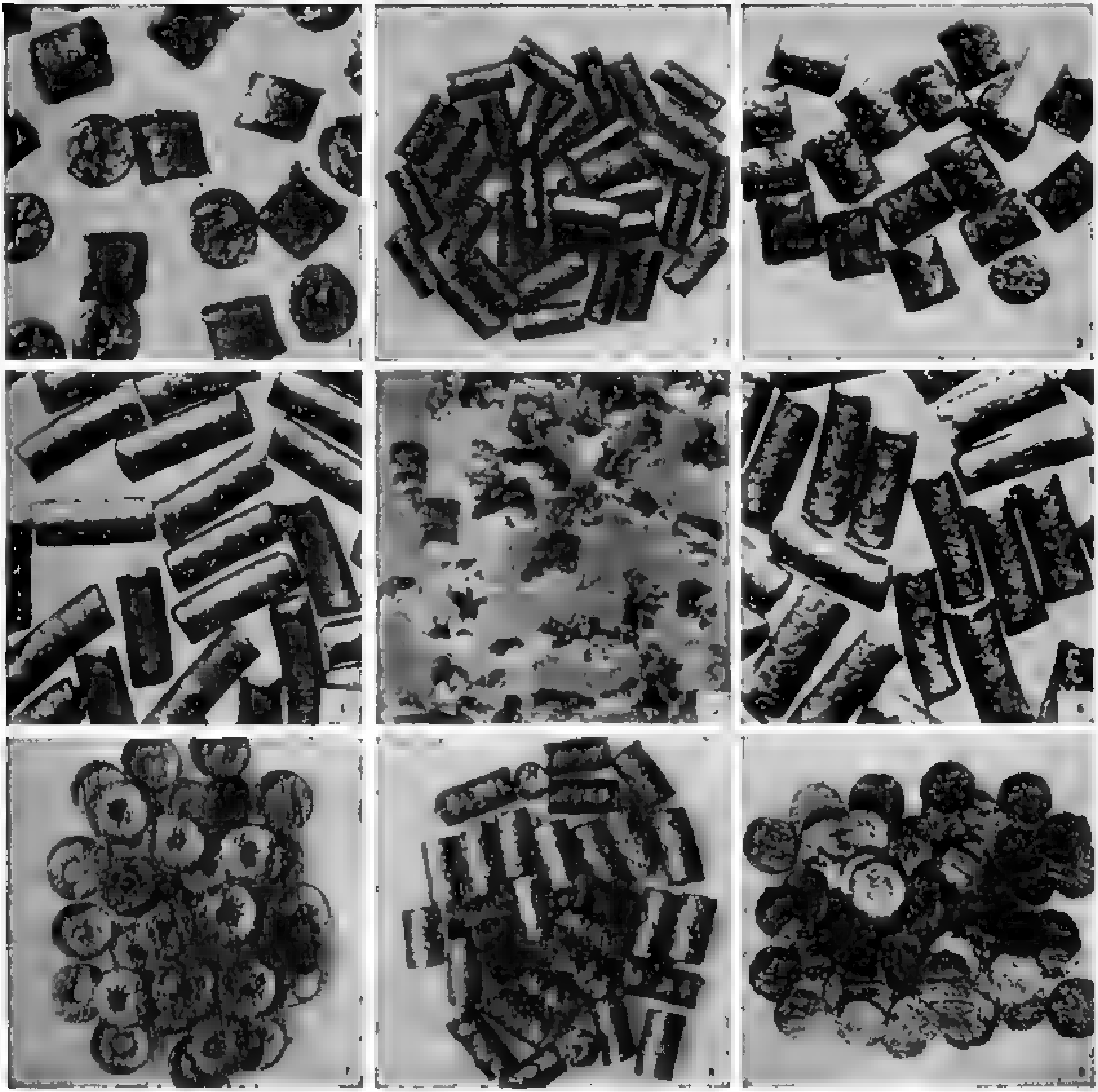
No. 80 was designed to give its best results at a burning pressure of between 14,000 and 19,000 pounds per square inch. Since this is in excess of usual handgun limitations, tests by both reloaders and Du Pont clearly show that it performs with excellent and uniform accuracy at pressures as low as 7000 pounds. No 80 is also recommended by certain writers in sporting magazines for their so-called "super-power" loads. In this the writer does not care to stir up an argument, but numerous tests have demonstrated it to be *entirely unsatisfactory* for high-velocity revolvers, developing pressures so excessive as to come close to the danger point. As a matter of fact, my good friend Elmer Keith, in experimenting with #80 in his .38 Special and .44 Special heavy loads, has wrecked several revolvers. In fact, he has had his revolvers more or less constructed with a view to handling this powder, a precaution which we do not deem advisable, since superior powders are available. For rifle use, however, in such cartridges as .38/40, .44/40, the obsolete but still used .32/40 and .38/55, not only standard full-charge loads can be obtained, but also loads approximating the so-called "high-velocity" types in these calibers.

No. 80 burns a good deal more slowly than the now obsolete #75 and faster than Rifle Smokeless #1. In many ways it is far superior, since it is by no means as hygroscopic as the older powder; it keeps well and stands up without deterioration even when stored in loaded cartridges for a long time. The writer loaded a batch of .30/06 mid-range target loads with #80 and left them in a friend's attic for approximately five years, forgetting them entirely. A few months ago he stumbled on the package and took them out on a clear windless day for a trial. They proved to be equal in accuracy at 50 yards to any load ever assembled for shooting at that range. There was no indication of corrosion or breakdown of the powder, although we opened a couple before the firing started.

One major advantage of #80 is that it meters through the average powder measure with excellent accuracy due to its shape of grain. In the average powder measure, such as the Belding & Mull, Ideal, Bond, Comer, etc., it meters sufficiently close so that once the measure is properly adjusted there is little, if any, necessity for weighing the powder charges for these reduced loads. Also it "bulks" up well; in other words, it properly fills much of the cartridge case and thus has an excellent loading density. It ignites perfectly even in small charges. It is cool burning, thus excellent for plain lead-base bullets; and in the .30/06, with gas-check bullets, velocities up to 2000 f.s. can be obtained.

There is one feature of #80 which is worthy of more than passing consideration. It has a so-called "critical point," and charges greater than this "critical point" should never be used. Experimentation with #80 in numerous cartridges has demonstrated to the writer that beyond a certain point the heads of the cartridge cases swell badly and stick in the gun.

It is extremely difficult to make a powder which will perform well for mid-range charges in high-power cartridges. The powder must be quick-



A few assorted powders suitable for loading in both handguns and rifles. These illustrations show grain shape but not grain size and are not comparative in that they were taken at different times with various cameras: No. 1, Du Pont IMR #1204, smallest granulation made having a perforation through the center; No. 2, Hercules HiVel #3, the latest of the HiVel series—somewhat smaller in granulation than HiVel #2, and excellent in a wide range of rifle cartridges; No. 3, Du Pont IMR #1147, designed chiefly for the Springfield cartridge, but well adapted to all military numbers; No. 4, Du Pont IMR #17½, contains tin and is being replaced by its successor IMR #4031; No. 5, Du Pont SR #80, one of the finest mid-range and gallery powders for all calibers of rifles; No. 6, Du Pont IMR #15½, now succeeded by an identically shaped powder known as #4064; No. 7, Hercules Lightning, excellent for medium and full-charge rifle loads; No. 8, Hercules HiVel #2, the coarsest granulation of any powder on the market today; No. 9, Hercules Unique, the best powder for heavy loads in handguns, as well as light loads of gallery strength for almost any caliber of rifle. For handgun use, excellent velocities and low pressures can be obtained

burning but not too quick. In other words, it must act at a point somewhere between the extra-rapid-burning powder used for smokeless blank cartridges (E. C. Blank Fire) and the powder used for full-charge loads. With too heavy a charge in the case, pressures mount extremely rapidly and are inclined to cause a minor detonation in the powder, crystallizing both the brass cartridge case at the head and the chamber at that point. The result is a possible rupture. No. 80 powder is an excellent propellent but it has its limitations the same as any other powder. Its limitations should be watched and heeded. In the use of #80, abide by the so-called "maximum" loads recommended by the powder companies and do not attempt to go beyond this point. This advice is of even more importance when using mid-range powder than when using the so-called full-charge types, as the user of #80 is liable to get a false impression of his security.

Sporting Rifle #80 was brought out as a result of a peculiar group of circumstances. When the Du Ponts absorbed the California Powder Works they took over an outfit which had for a great many years manufactured a line of fine-grained .22-caliber Smokeless Rifle powders marketed to various loading companies only under the trade name of "CPW .22," "CPW Automatic," etc. These were hard-grained, white, sand-like powders. Shooters of some twenty years ago will recall the use of these powders in the .22 Automatic rifles of the class of the Winchester Model 03. The burning of these powders gave a pungent and strange smell. They were extremely popular but were unjustly blamed by some shooters as being highly erosive. We have since learned that the erosion blamed on these powders was for the most part caused by the primer. Even some of the smokeless .22 Shorts of twenty years ago, when loaded with these CPW powders, had nearly as much priming as they had powder.

These powders, however, were rather sensitive to moisture, and in 1913 Du Pont chemists commenced improving them as a number of German smokeless brands were getting altogether too much publicity in the United States and Great Britain. American loading companies were calling for better .22 smokeless powder, and the Du Ponts were anxious to get into this game as they found that Lesmok powder was far more dangerous to make than black powder. Du Pont chemists incorporated in with the .22 CPW powders a deterrent and stabilizing agent, and the result was a somewhat slower-burning powder which eventually became known as "#80." When the powder was first manufactured is not definitely known, but Lot 3 went into the factory in June 1914. The slower rate of burning adapted #80 to full charges in larger capacity cases such as the .25/20, and mid-range charges in still larger ones. For the handloader only normal loads should be used, and no experiments should be tried in attempting to develop high-pressure results either in rifles or in handguns. This powder develops what a great many technicians prefer to term "high base pressure" in the rear end of the case. With full charges it frequently causes stuck shells, and in single-shot actions sometimes breaks the extractors.

Du Pont MR #20. Introduced 1909. Discontinued Commercially 1927. This much-maligned powder has been manufactured and consumed in greater quantities than any other type of smokeless powder built in America. It has served under different names and has been known successively as Du Pont 1909 Military, Du Pont Military #20, and Government Pyro .30-caliber DG. This powder throughout the World War was used by the United States Army in the famous .30/06 cartridge. At the close of the World War, various American plants were turning out over 1,000,000 pounds of it each day, seven days a week. It has an interesting history.

This powder was developed by Du Pont during the years 1908 and 1909 to replace the experimental military rifle powder known as "Rose-aniline Pyro," a tubular-grained pink propellent which was highly unstable. I have not seen this early powder for some years, as the sample in my collection deteriorated many years ago and had to be thrown out. No. 20 is probably one of our first successful single-base dense military rifle powders. Government specifications indicate that the tubular grains are .03 inch in diameter and grain length is .085 inch. Until it was adopted, the Government, with the exception of experimental batches, used nothing but the old W. A. and Du Pont 1908 Military (nitroglycerine) powders in the Model 1906 cartridge. Although Du Pont abandoned Pyro DG some years ago, it is still available in large quantities at this writing from Uncle Sammy's arsenals to members in good standing who have paid their annual toll to the National Rifle Association. It is by no means as good as many of the modern IMR powders, but it has a way of coaxing a bullet from here to there and doing it very well.

No. 20 is not as flexible as some writers claim and a great deal more so than the remarks of others would indicate. It can be used in most large-capacity bottle-neck cartridges ranging from the .22 Savage, .22 Niedner Magnum, .25 Reming-

ton, .257 Roberts, and .25 Neidner-Krag up through the military chain into the .35 and .400 Whelen. In that long straight .405 WCF case it also does a good job. No. 20 is designed to burn at pressures ranging between 45,000 and 50,000 pounds. However, it works satisfactorily as low as 40,000 pounds in the Krag and up to 55,000 pounds in the .30/06 and some of the modern smaller bores. Du Pont #20 is very similar to numerous other military rifle series. However, it is wrong to assume that all members of the Du Pont MR family were straight nitrocellulose powders. At least a couple of them were in the nitroglycerine class. No. 20 is about half-way between #10 and #21 in its speed of burning and differs essentially from the latter two in size of grain. It established more records for accuracy than any other single-base military rifle powder either in this country or abroad, and it was due to the excellence of Military Rifle #20 or Pyro DG, as the Government always called it, that the excellent qualities of the .30/06 cartridge were developed. It doesn't work well with reduced charges or with cast or gas-check bullets.

Government Pyro DG. Introduced 1910. No Surplus Supplies Available. This powder is essentially #20, but while #20 was standardized in canister lots, the Government powder never has been and will vary tremendously in ballistics in different lots. It must not be used for reloading under Du Pont #20 specifications. When purchased from the Government invariably proper loading specifications will be listed to develop, with that particular lot, the standard Service load in the .30/06 with 150-grain bullet of 2700 f.s. muzzle velocity. The fact that this measurement may correspond favorably with the equivalent of Du Pont #20 means but very little, although it can be used as a guide in loading other charges if no attempt is made to approach maximum velocities and pressures.

Around 1903 the Ordnance Department officially abandoned the Krag rifle and the .30/40 Army cartridge and concentrated upon the then new ".30/45 Government" or ".30 Model 1903" as it became known officially. In developing this new cartridge the makers had taken the old 220-grain jacketed .30-caliber, and loaded it into a larger capacity rimless case in order to obtain the great military advantage of clip loading. They also retained the then famous W. A. .30-caliber powder which had established records for accuracy and stability. They loaded this nitroglycerine powder in approximate 45-grain charges to burn at pressures of 40,000 to 45,000 pounds. The muzzle velocity of the original .30/03 cartridge was 2300 f.s., but this caused such excessive recoil and erosion that this velocity was abandoned and officially dropped to a new standard of 2200 f.s. Rifling during the first few years was purely experimental. Some of the first rifles had an eight-inch twist which lasted a surprisingly short time. Rifling was then established at one turn in ten inches.

The Springfield got off to a very poor start, as at all matches the Krag outshot the now popular Springfield. During 1904 and 1905 the Government experimented with Spitzer bullets and eventually adopted the 150-grain pointed type. At the same time it shortened the neck of the cartridge case a mere .06 and called in all guns to be rechambered. The Ordnance Department then experimented for several years with an entirely new type of powder known as "Pyro" or "Pyrocellulose," which was said to be far less erosive. The new powder was made by both Du Pont and Government powder factories. It was very beautiful, being bright pink in color and in rather long slender grains. It first appeared on the target ranges in 1907. The trouble, however, began when ammunition commenced to throw unaccountable shots at 800 yards and over. Just why this occurred is not known today. It may have been that a series of shots developed a heavy, sticky fouling in the barrel which would suddenly be carried out by another shot. Excessive metal fouling may have had something to do with this inaccuracy, but very definitely the new 2200 f.s. velocity ammunition was far from being satisfactory.

The boys that had to use the Government issue containing this pink powder tried it, but those who could afford to buy commercial stock visited the shops on Commercial Row at the National Matches and bought from the ammunition salesmen some .30/06 cartridges loaded with an exceptionally accurate Du Pont powder known by the odd name of "NGS2." This was nothing more nor less than a form W. A. .30-caliber toned down to but 15% nitroglycerine and made to the same grain dimensions as the new Pyro powder. It was most accurate, pleased the shooter in all respects, but neither Du Pont nor the Ordnance Department was sold on it in the least. Du Pont wanted straight nitrocellulose powder. The Ordnance Department agreed, as it was getting tired of rebarreling good rifles after a few shots. But the Ordnance Department boys had other worries on their minds. The nice pink Pyro was commencing to lose its rich schoolgirl complexion and taking on a sort of "yaller" hue. This loss of color indicated a change in the stability of the powder, it

having been colored pink for the sole purpose of enabling one to judge its condition.

A sample of this powder in the author's collection was discarded many years ago because of decomposition. Notes are as follows: "Discarded from sample collection completely disintegrated. Under microscope some grains densely coated with yellow, others plain white crystal cake. White cake under 100X magnification appears to have no crystalline structure. Under pressure, white cake breaks readily to reveal semi-crystalline structure, almost transparent. Tubular grains badly shrunken, almost dissolved and sweated clear crystals having the appearance of wet sugar. Crystals irregular in shape. Remaining powder appears like cloudy or dirty amber. Faint nitric acid odor."

The Ordnance Department, however, was worried primarily because about this time the French Government, perhaps the original proponents of a nitrocellulose rifle powder, was commencing to have trouble with spontaneous combustion of decomposing powder in its magazines and ships. France had just lost two of the largest battleships in her Navy, and accordingly the following spring (1909) Du Pont announced the development of an entirely new powder of straight nitrocellulose composition but containing an absolute stabilizer known as diphenylamine, an ingredient which has since proved to function perfectly in all respects, hence the name "Pyro DG" (diphenylamine graphited). The new powder was graphited to assist in better gravity feeding through loading machines and to remove any chance of sparks occurring in handling through generated static electricity. This new powder was given the name of "1909 Military," and this title was retained until 1914, when it was changed to "Military Rifle #20," but always known by the Ordnance Department under the official title of ".30-caliber Pyro DG."

Hercules #308. Introduced 1915. Discontinued 1930. This powder is practically identical with #20 and with Pyro DG and is merely the Hercules designation of the same powder. It was first manufactured by Hercules during the war and marketed to handloaders in canister lots from 1915 up to the time of its discontinuance.

Du Pont 1908 Military (MR #19). Introduced 1908. Discontinued 1909. Large black graphited tubular grains, length .09, diameter .045. This powder is none other than the powder previously mentioned under the designation of "Du Pont NGS2." It was sold in canister lots for some time after its manufacturing discontinuance under the designation of "Military Rifle #19." This was a nitroglycerine powder, and it had a very useful life of a few years. Although its manufacturing was discontinued, it was not officially discarded and manufacture was again taken up by Hercules and marketed under the name of "HiVel." This was actually HiVel #1, long since discontinued and replaced by the new HiVel officially known as "HiVel #2," approximately the same granulation, and its later development "HiVel #3," a finer grain size.

Du Pont MR #10. Introduced in 1910. Discontinued 1915. This powder was designed primarily for use in the .280 Ross cartridge at the time Sir Charles Ross developed the famous (or infamous) straight-pull rifle. The .280 Ross cartridge was a large capacity case and has not been widely used in this country because its size requires a Magnum or extra long type bolt action similar to the Magnum Mauser. The shell has sharply tapering sides and bottle neck. Du Pont #20 failed to perform well—it burned too rapidly; so #10 was produced with a larger grain and therefore slower burning. Early developments in the vicinity of 1910 showed that the .280 Ross cartridge could be made to drive a 143-grain bullet at 3100 f.s. and the 180-grain bullet at 2700 f.s., superior to anything else during its day, and to a great many since.

No. 10 was a tubular powder having a grain diameter of .033 and a length of .12 inch. These grains are about as long as anything ever developed in this country for small arms. Because of its grain size it doesn't handle well in powder measures and should be weighed for best results. Although this powder was first manufactured in 1910 and used by loading companies at that time, it was not released for canister sale until 1912. Its working pressure is from 52,000 to 57,000 pounds, and while it does not burn properly at low pressures, at high pressures of 60,000 to 62,000 pounds it can be used successfully. However, it should not be loaded at these excessive pressures today, since very few cartridge cases can safely handle it. It was marketed entirely for use in the .280 Ross and was not sufficiently flexible for reloading in other cartridges until Newton brought out his line of .256, .30 Newton and .35 Newton cartridges. In the .256 Newton, it can be used at velocities of about 2850, using about 46 grains with the 123-grain bullet.

Du Pont MR #21. Introduced in 1913. Discontinued 1926. Tubular graphited grains, length .04, diameter .03. This powder was designed as a companion to Du Pont #20 for full-charge loads in such cartridges as the .25/35, .22 Savage Hi-Power, .30/30 and the Remington Autoloading series. Although developed in 1913, it was not re-

leased for canister sale until 1914. It is a somewhat faster-burning powder than #20. Samples in my collection show that it has a black tubular-form grain, very similar to the popular IMR #18. It had a much wider range of loading than any of the other MR series on the market and performed best at a burning pressure of between 36,000 and 41,000 pounds, performing with reasonable success as low as 30,000 and up to 45,000. It is this powder which made the .250/3000 Savage a 3000 f.s. cartridge and for many years was the standard of loading companies in many of their bottle-neck cartridges. It works in the Krag and I have obtained some excellent accuracy with it in the Springfield, although velocities were at a point between what we might call "mid-range" and "full-charge." It can be used with both gas-check and metal-jacketed bullets giving velocities between 1400 and 2000 f.s., but is not a successful powder for use with plain-base cast bullets. Its small grain makes it excellent for handling in powder measures, and it was the most flexible of any of the regular burning or military rifle powders. Do not go beyond recommended charges on the canister if you should be able to locate any of this powder.

Du Pont IMR #15. Introduced in 1914. Discontinued About 1917. Black, tubular grains, length .085, diameter .035. This powder, the first of the so-called "Improved Military Rifle" series or progressive-burning powder, although it was used by loading companies in 1914, was not released for canister sale until the following year. The history of this powder is decidedly interesting. Previous to 1914 the British Government designed an entirely new rifle *and cartridge*. This later cartridge was 7-mm. caliber, known as the .276 British, and was intended to be used in this new rifle; when war was declared, however, England dropped all plans for new and untried ammunition but continued with the rifle, many thousands of which were manufactured in this country. When America got into the war, she took over all contracts held by American arms factories, changing the .303 British cartridge specifications to .30/06—in other words, reverting back to a rimless type of cartridge for which the rifle was originally designed. This rifle is our Model 1917 or Enfield.

The experimental British cartridge dropped into oblivion. Nevertheless, the British Government was thoroughly convinced at the start of the development work that it could never obtain any degree of success if it adhered to its use of Cordite powder in the proposed new development. Du Pont was asked to design a powder for it, since none of the existing powders appeared to develop its potential possibilities. Hence was #15 born, the first American progressive powder designed to operate in that cartridge at 55,000 pounds and to give 2900 f.s. velocity to a 165-grain bullet in a 25-inch barrel. This started powder companies throughout the world experimenting with progressive-burning powder, with the result that practically every nation today uses such a powder in its major line of both sporting and military cartridges. No. 15 is a dense progressive-burning straight nitrocellulose powder of tubular granulation. It is a very flexible powder, gives higher velocity with equal pressure than any of the MR series, and in many cartridges will add 300 f.s. to the maximum loads with the old-type powder. Essentially it is a progressive-burning form of #20 and should be rated in that class. Due to its grain shape and weight, it cannot be metered as accurately as a fine-grain powder in most types of measures, but still will deliver the goods in the average powder measure if no attempt is made at the so-called "maximums." It is more flexible than #20 but has a wide range of uses, chiefly in bottle-neck-type cartridges. It is suitable, of course, only for full loads with metal-jacketed bullets.

Du Pont IMR #13. Introduced in 1917. Discontinued (?). Black tubular grains, length .08, diameter .035. This powder occupies the same place in the IMR series that #10 did in the MR family. Grain shape is a bit more irregular than other members of the IMR clan, and in this respect looks more like the foreign types of tubular powders, few of which are as perfect in grain form as the Du Pont and Hercules series. It is slow-burning, designed for such cartridges as the .256 Newton, 6.5-mm. Mannlicher, .280 Ross, .30 Newton, etc., and while I have no records of its use, it should perform excellently in some of the more modern small-caliber bottle-necks such as the .22 Niedner, .25 Krag, and .257 Roberts. It is intended to burn best between 50,000 and 55,000 pounds pressure. Will burn satisfactorily at pressures as low as 45,000 but is erratic when smaller charges are used. It will run up as far as 60,000 pounds pressure in properly designed arms. In the .280 Ross a velocity of 3300 f.s. is obtained and 3225 in the .30 Newton. This powder should be weighed rather than measured because of its grain shape, but reasonable results can be obtained by a skilled operator using any of the standard measures.

Du Pont IMR #16. Introduced in 1916. Discontinued About 1927. Black tubular grains, length .085, diameter .03. No. 16 was for many years Du Pont's pride and joy. Introduced in 1916, it was very similar in appearance to IMR #15. It was the

most flexible of the IMR series at that time and was adapted to more different sizes and shapes of cartridge and a wider range of velocities and burning pressures than anything previously produced. It performs perfectly at pressures as low as 30,000 pounds and equally well up to 55,000. Although a discontinued number, with modern gilding-metal-jacketed bullets it is superior to the "½" series of powders such as 17½, 15½, etc., in a great many loadings, burning much cleaner and fouling the barrel less. It can be used in all cartridges from the .22 Savage Hi-Power, .22 Baby Niedner, .25 Niedner-Krag, .257 Roberts, and other ultra-modern cartridges through the .30-caliber series, including the Magnums and up to the old .405 Winchester. During the latter months of the World War England carefully considered this for possible official adoption, and as a matter of fact used huge quantities of it in loading various cartridges, particularly those designed for aircraft use. No. 16 is still the powder listed in the latest issue (1929) of the *British Small Arms Manual* as "Du Pont Nitrocellulose" or "NCZ."

The handloader who in past years has tried #16 will recall its extreme accuracy and tremendous velocities. In the .30/06 Springfield the 150-grain Old Service bullet or in fact the present-day 150-grain expanding types can be started on their journey at velocities up to 3000 f.s. In the .250 Savage the 87-grain bullet can be jogged up to 3250 or 3300 f.s., about as heavy as with any of the more "modern" powders. It is somewhat faster-burning than #15 and in actual burning qualities was rated between IMR #18 and IMR #13.

No. 16 was long the author's favorite powder, and he never obtained the accuracy using 17½ (its successor) that he was able to secure with this old powder. Government tests using it with the old 150-grain bullet indicated a barrel life in the .30/06 in excess of 20,000 rounds—with the least erosion of any powder ever tested. As a matter of fact, Army reports indicate that erosion of #16 was but slightly greater than half that of #20. Despite complaints from a great many reloaders, the writer always found that it measured well in such measures as the FA bench type, the Ideal and the Belding & Mull visible.

Du Pont IMR #18. Introduced in 1915. Discontinued 1930. Black tubular grains, length .05, diameter .03. This was the "short-cut" member of the IMR family. You will see that closely following the introduction of #15 for big cartridges in the .30/06 class, its excellent qualities created a demand for a powder suitable for small-capacity types such as the .30/30, .22 Hi-Power, .25/35 and similar popular hunting numbers. Powders built on the IMR #15 formula were reduced in grain size to accommodate these cartridges, necessitating the use of faster-burning propellents. It was very similar to IMR #21 in size and shape of grain and was intended to replace that member with a progressive-burning type. It was designed to function at pressures running between 33,000 and 38,000 pounds, but it soon proved in the hands of experimental handloaders that it was a very flexible and efficient powder.

The writer has obtained superlative accuracy in the .30/06 cartridge for mid-range loads in pressures as low as 20,000 pounds and at the same time has used it with full charges up to 52,000 or 55,000 pounds. It is one of the few dense nitrocellulose powders suitable as a propellent for gas-check bullets and with certain hard-alloy castings can be used with plain-base bullets. I have obtained excellent performance in the .30/06 with this powder in low charges at an operating pressure below the 20,000-pound mark when used with tight-fitting flat-base bullets cast in 1 to 10 metal. It is highly desirable in certain charges designed to develop standard velocities, but care should be exercised in attempting to approach the high-pressure limits. In the .30/06 Springfield, 47.3 grains will drive the 150-grain bullet up to 2700, but this charge should not be exceeded unless one knows very definitely the results developed by his loads. Furthermore, accuracy at the high-pressure limits is by no means perfect. Because of its granulation, #18 is one of the smoothest powders to run through any of the standard types of measures. It is quite possible, with a good measure and reasonable skill and care, to throw charges to within 1/10 grain.

Hercules #300. Introduced 1916. Discontinued 1932. Black tubular grains, length .08, diameter .03. This powder was on the market for a short time and was almost identical in performance with Du Pont IMR #15. It was a nitrocellulose or single-base powder of the progressive-burning type, and while not exactly identical with its Du Pont counterpart, general comments on one will apply equally well to the other. It performs excellently in a wide variety of cartridges from the .22 Hi-Power and its modern variations of Niedner, Krag, etc., up through to the .30/30 group of hunting types and then into the Springfield class. It is in the latter class that I had most of my experience with it, dating back to the mid-1920's. It was a very excellent powder and failed to acquire more popularity because its manufacturers preferred to push the sale of their excellent nitroglycerine-type powder—HiVel #2. No. 300 burns best at pres-

sures from 38,000 to 52,000 pounds, and while it can be used in a variety of cartridges, it lacks the flexibility of the Hercules double-base powders and cannot be used for reduced charges or mid-range loads in any cartridges to which it is adapted. Any appreciable underloading invariably results in erratic ignition and burning, with consequent effect on accuracy. It works best when used in standard loads with the heavier group of bullets designed for a given caliber.

Du Pont IMR #15½. Introduced 1919. Discontinued 1934. Black tubular grains, length .08, diameter .03. No. 15½ is the IMR powder replacing #15. The story of its origin is interesting. During the war, experiments by the French Government revealed that a small quantity of tin when added in the form of fine flakes or foil seemed to reduce the tendency of 4-inch to 6-inch artillery shell driving bands to foul barrels. Artillery had been encountering serious trouble in accurate barrage fire and in direct fire through excessive fouling or "coppering" of the bore by the rotating bands of the shells or "boroulettes." It was said that this condition was so extreme that in rapid fire one could break off thin strips of protruding copper from the muzzles of the guns. The French discovered that tin solved their problem, so that to each battery there was issued a supply of layers of tinfoil, scribed across much like chocolate bars, which could be broken up and measured out rather accurately. This foil was placed on top of the powder charge and against the base of the shell where the heat of the burning charge would melt it.

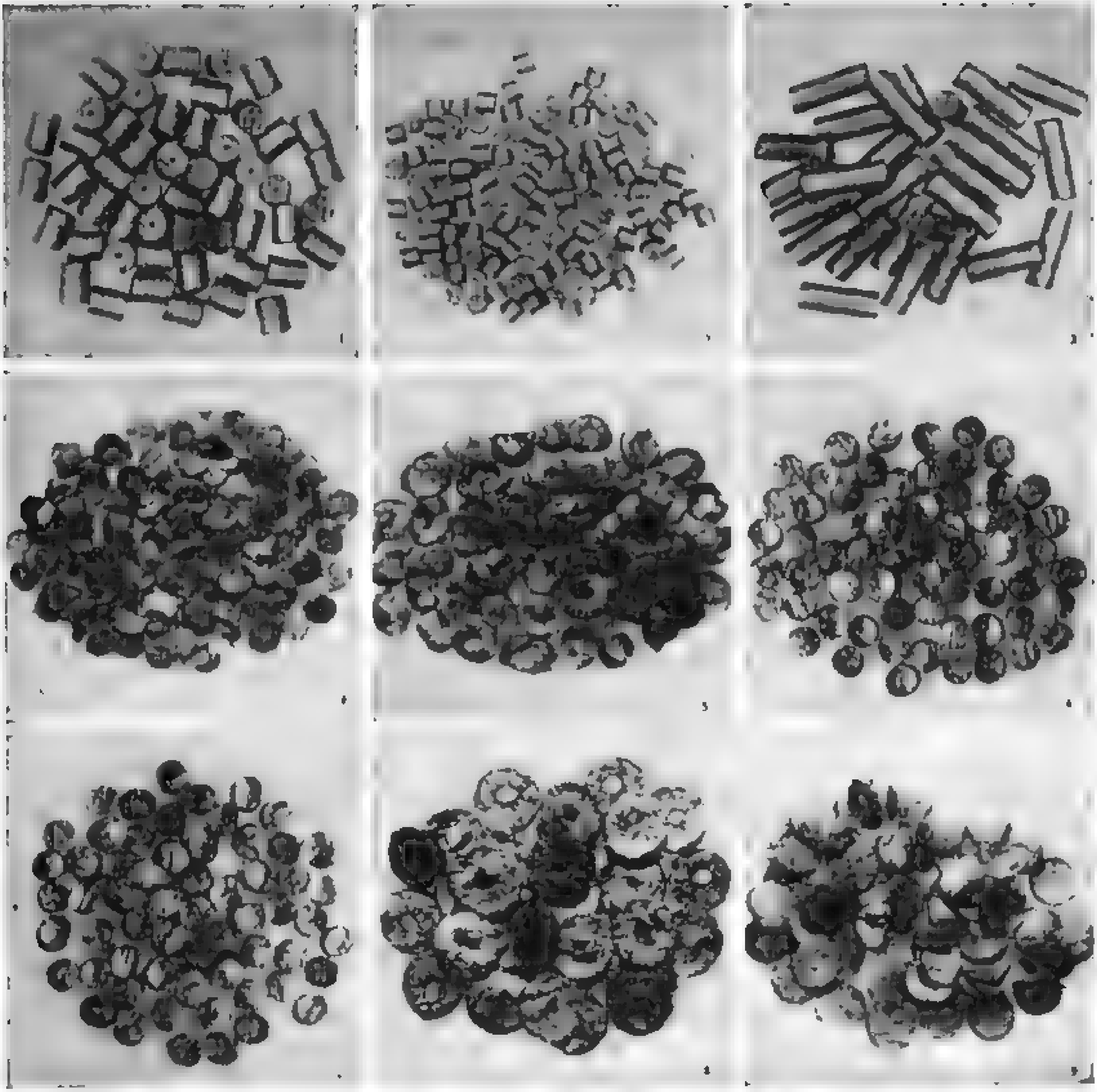
When Du Pont learned of this experiment, C. I. B. Henning, one of Du Pont's greatest chemists, went to work on it. Henning later became a director and a powerful figure in the operating department. He had been brought up among powder makers, having originally been with the old California Powder Works at Santa Cruz. Working with various experimental lots of IMR powders, he began adding various amounts of tin, not loosely, but *incorporated into the powder.* His results, all obtained before the close of the war, were entirely successful. The most practical of these powders was known as "Experimental 1015." When released to the canister trade, it became known as "IMR #15½."

Early developments of #1015 and #15½, while they proved to be extremely interesting to the Du Pont laboratories, did not appeal to me by any means. I had a hard time using up this experimental stuff for the very simple reason that a few shots would make the inside of a barrel look much the same as a well-used chimney. This was caused by a powder fouling in the form of metallic tin and gum deposited evenly throughout the bore. Without a shadow of doubt this tin lubricated the bullet, particularly in the use of such types as the 180-grain Palma Match, with its heavy cupro-nickel jacket, when used in the .30/06. Removal of the fouling, however, was by no means a simple task. It required heavy applications of powder solvents plus brass-bristle brushes and all the elbow grease one had to spare. It was soon found, however, that the metallic content of the early samples was much too great and most of this overdose of tin in the barrel was eliminated by the time #15½ was placed on sale in canisters.

Although no official announcement has ever been made from the Du Pont laboratories, this metallic tin content has been reduced two or three times, which doesn't affect the ballistics but makes for a cleaner-burning powder. There is really little use for the metallic tin content with present-day bullets, since cupro-nickel jackets are rapidly becoming a thing of the past. Gilding metal, together with its patented variation containing zinc and known as "Lubaloy," or "Gilding Metal," has crowded the necessity for this class of powders more or less from the market. I would personally prefer the old #15 and will not feel bad to see this powder fall by the wayside to be replaced by IMR #4064.

An interesting phenomenon is noted by the reloader who uses any of these "½"-series powders. Recovered bullets, particularly of the gilding-metal-jacket variety, are beautifully tin-plated at any part of the jacket which contacts the bore. Many hundreds of these bullets have been recovered by the writer, and the tin plating persists, even on bullets fired with powders lacking tin content, for more than ten shots after the last "½" powder shot is fired through a barrel. This may give one an excellent idea of the scrubbing necessary to remove this tin plating from bores.

Du Pont IMR #17½. Introduced About 1923. Discontinued 1933. Black tubular grains, length .08, diameter .03. This is another "tin-can" powder, and until the past year or so was the most popular member of the Du Pont series of IMR's. Essentially it is #16 with added tin, but was not released until the tin-content qualities had been thoroughly tested in #15 and most of the original faults overcome. It does not burn as clean as #16 but was designed to replace it. It has a wide tolerance range and will perform in any cartridge in which its predecessor can be used. It is effectively replaced by the new IMR #3031.



A few excellent dense powders suitable for reloading: No. 1, Du Pont IMR #4320, one of the latest powders designed to replace IMR #1147; No. 2, Du Pont IMR #4227, another of the newer types of powders designed to replace IMR #1204 and does not contain tin—the same size granulation as #1204; No. 3, Du Pont IMR #3031, the first of the new Du Pont series, and designed to replace #17½; No. 4, Hercules Bullseye, the oldest revolver powder on the market and still one of the most reliable—granulation the finest in any American smokeless powder; No. 5, Hercules Herco Shotgun, suitable for gallery and medium-power loads in handguns—must be used carefully—not suitable for rifle use; No. 6, Hercules #2400 Rifle, excellent for small-capacity cartridges, may be used in certain handgun cartridges for heavy loads; No. 7, Hercules #2401, is similar to #2400 except in rate of burning and has never been sold in canisters; No. 8, Hercules Sharpshooter, excellent for rifle use; No. 9, Hercules Infallible Shotgun, intended only for shotgun use, but is excellent for full-charge loads in revolvers—must be loaded slightly lighter than Hercules Unique, approximately one grain less for safety

Du Pont IMR #17. Introduced in 1915. Discontinued 1925. This powder was essentially a minor variation of #16 designed for wartime use of the British Government in the .303 Lee-Enfield cartridge, particularly for aircraft service. Many hundreds of tons of it were used by Great Britain.

In addition to use by the British Government, many thousands of pounds of it were shipped into Canada to be loaded into .30/06 cartridges for the United States, and it was widely used by various loading companies in this country on Army contracts, particularly in the Model 1917 .30/06 Tracer cartridges. In addition, it was used in loadings for foreign governments of the 8-mm. Lebel and the 7.62-mm. Russian military cartridge. Much of this old-time ammunition was broken down by reloaders after the war, and large stocks of the powder were reloaded. It is reasonably flexible, but loading data on it are difficult to locate.

Du Pont #1204. Introduced in 1925. Discontinued 1935. Black tubular grains, length .025, diameter .025. This is the smallest granulation of any powder in the IMR series, and Wallace Coxe, Du Pont's ballistic engineer, once told me that it was the smallest-grained *perforated* powder ever produced. It handles excellently in powder measures because of this granulation, but since it is so fine-grained, it will settle rapidly if a measure is not handled uniformly, thereby throwing overcharges. This is not the fault of the powder but of the operator; a skilful handloader can readily avoid these problems. No. 1204 was designed for use at pressures in the vicinity of 18,000 pounds. Its makers originally believed it to be lacking in flexibility and insisted that its use should be limited to small-capacity cartridge cases like .25/20, .32/20, .38/40 and .44/40. The writer's first experience with this powder in 1926 was with Lot #4. He found it to be a remarkable powder in many ways, and despite numerous complaints about loading density, began experimenting with it for reduced charges in the .30/06 *against* the recommendations of Du Pont. He found that for 100-yard loads with standard bullets both in metal-jacket and gas-check varieties, it was an excellent performer even in light loads, and this powder is now recommended by Du Pont for this purpose. It must, however, be kept near the primer when large-capacity cases are used. No. 1204 can claim another distinctive feature—it made possible the development of the Hornet cartridge. No other powder during that period would produce the superlative accuracy obtained by Hornet bullets in the tiny case. It will still deliver the goods. It will also operate at pressures much lower than 18,000 and with reasonable performance up to 40,000. In accuracy it is equal to numbers 75 and 80 when properly loaded, although by no means as flexible. Its successor, IMR #4227, does a much better job, however, in all cartridges.

Du Pont IMR #1147. Introduced in 1923. Discontinued 1935. Black tubular grains, length .04, diameter .03. This powder was brought out for use in cartridges in the .30/06 class but has been found to be excellently adapted to the Krag, 6.5-mm. Mannlicher, 7-mm. Mauser, 7.62-mm. Russian, 7.9-mm. Mauser, and 8-mm. Mannlicher. It is a fine-grained nitrocellulose performing best with jacketed bullets only, ranging from the 110-grain up to 220- and 225-grain bullets in the .30/06. With 110-grain High Speed a 50-grain charge will give a muzzle velocity of 2640, while 62 grains are required to get the maximum velocity of 3320 f.s. with a pressure in the vicinity of 55,000 pounds. Because it requires heavy charges it has never been excessively popular with reloaders, since equal accuracy and velocity can be obtained with other members of the IMR family with from eight to ten grains lighter weight of powder charge. Early canisters of this powder bore the title "EX-1147." Those recently used have dropped the experimental letters. This powder is effectively replaced by the new IMR #4320.

Du Pont IMR #1185. Introduced in 1926. Discontinued 1938. Black tubular grains, length .085, diameter .03. This powder was designed chiefly for Government use with the 173-grain Mark I bullet in the .30/06. It has never been sold in canisters for reloading, although it has been available for many years to members of the National Rifle Association in bulk lots on direct purchase from Government arsenals. Since it is not a standardized powder and differs lot for lot, ballistic specifications must be checked closely with those listed; and while it may be overloaded to a reasonable extent, loads developing velocities in excess of standard are in the vicinity of the danger point.

Du Pont IMR #3031. Introduced in 1934. Still Manufactured 1948. Black tubular grains, length .085, diameter .035. This is one of the newest of Du Pont's developments. While first produced early in 1934 and used by a few experimenters and by loading companies, this powder was not released for canister trade until mid-1935. It is a modification of #17½ greatly improved, although in appearance it is almost identical and will replace #17½ in the IMR family. It contains no metallic tin, therefore eliminating fouling problems and making it one of the cleanest-burning

powders in the Du Pont family. Designed for use in cartridges of the .30/06 class, it is sufficiently flexible to take in the entire line from .22 Hi-Power and Magnums through the Military series and up to the .405 Winchester. It delivers velocities equal to #17½ with much lower pressures. It is cooler-burning and thus creates less wear and erosion in the barrel.

I have been using this powder since Lot #1 was manufactured, and one of the first loads with it was developed according to my specifications. Using FA components in the .30/06, including the FA 173-grain Mark I boat-tail, 38.8 grains gave a muzzle velocity of about 2260 f.s. with a pressure of 29,300. At 100 yards this particular load in my Springfield Sporter can be depended upon to make 1¼-inch 10-shot groups and on occasion with telescope and muzzle and elbow rest has produced groups as small as ⅞ inch center to center. Beyond a doubt this powder will, during the next few years, crowd #17½ from the field. It will do everything that #17½ will do, and in addition leave the barrel as clean as one could desire. We have used it in various calibers from .22 Magnums up, and in every case accuracy has been superior to that obtainable with any other powder, particularly if sufficient experimentation is conducted with individual loads to determine the proper balance.

We have used it experimentally with pressures as high as 65,000 pounds, and on a special test with selected components in a stock model Winchester 54 7-mm. using the Remington 139-grain gilding-metal-jacketed Military type (FMJ), a 100-yard group was shot in which the entire ten shots could be *covered* by the head of a 7-mm. or .30/06 cartridge case. This is the smallest 100-yard group the writer has ever seen. The pressures, of course, were far in excess of safety limits, and velocity was tremendous, even in the 24-inch standard-length barrel. Loadings for this new powder have been included in the various tables in another part of this book. It is one of the few powders on today's market which have made possible the superior accuracy and velocity obtained with the .22 Magnums now being developed and such cartridges as the .257 Roberts and .25 Niedner-Krag. Watch this powder.

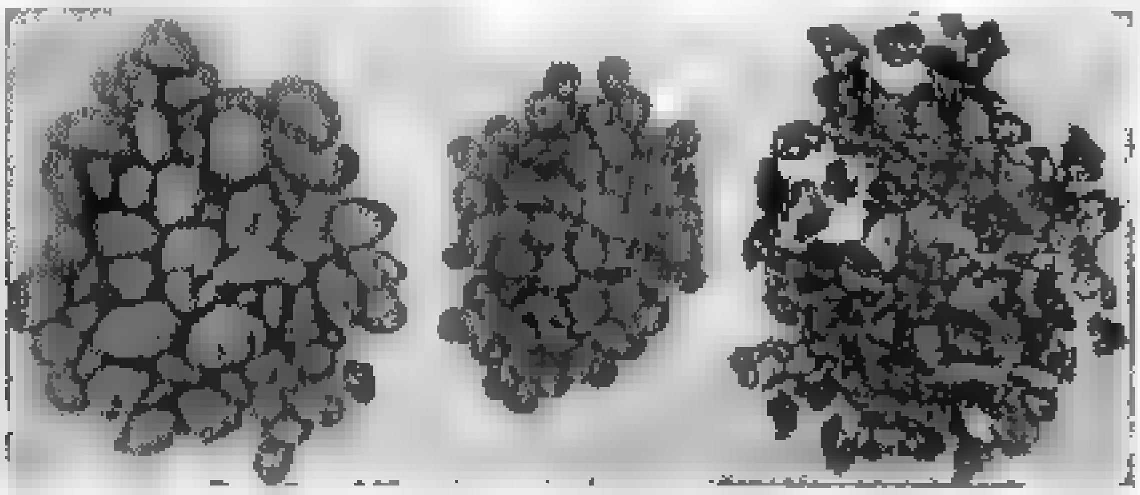
Du Pont IMR #4064. Introduced in 1935. Still Manufactured 1948. Black tubular grains, length .085, diameter .036. Although the first lot of this powder was manufactured in 1935 and in use by the author almost as soon as manufactured, it did not become available for canister sale until August 1936. This powder has the general characteristics of its predecessor, #3031, although it is somewhat slower burning, more along the lines of #15½. When the demand falls off for the earlier powder it is the plan of Du Pont to discontinue #15½, as #4064 effectively replaces it. The powder is extremely flexible and some tests run with Lot #1 indicate that 41 grains will give a muzzle velocity of 2275 f.s. in the .30/06 using FA components and the 173-grain Mark I bullet. This load develops the absurdly low pressure of 29,000 pounds With 52 grains and the same components, a velocity of 2825 f.s. with remarkable accuracy is obtained, yet this tremendous velocity is obtained with the mean pressure of 51,000 pounds.

Du Pont IMR #4198. Introduced 1935. Still Active 1948. Black tubular grains, length about .085, diameter .025. This is a third member of the Du Pont super-improved line. It is similar in composition to #3031 but considerably faster-burning. It is designed to replace IMR #25 and #25½, two very excellent powders, which for some strange reason have never been sold in canisters. This powder is designed for use in cartridges of the .22 Hi-Power, .25/35, and .30/30 class. It is extremely flexible, however, and performs excellently between 30,000 and 53,000 pounds. It does, however, require a considerably lighter charge to obtain equal velocity with a given bullet. Some of my loads with Lot #1 tested early in 1935 show that 33 grains develop a muzzle velocity of 2260 f.s. with FA components in the .30/06 with the Mark I bullet. This compares with the 38.8 grains of #3031 to obtain the same velocity; pressures run 5000 pounds greater—about 34,000 pounds. Accuracy is not quite as good as #3031 with this load. However, 37.0 grains give a muzzle velocity with the same components of 2450 with excellent accuracy and a pressure of 42,000 pounds; 39.8 grains run up a pressure of 50,000 pounds with a muzzle velocity of only 2575 f.s. This indicates that the powder is somewhat out of its class when used for loads approaching the standard velocity in these large-capacity cases.

Du Pont IMR #4320. Introduced in 1935. Still Active 1948. Black tubular grains, length .043, diameter .035. This particular powder is designed to fit the military sizes of cartridges for which #1147 was developed. It will replace the old IMR #1147 when the demand for that earlier powder drops off to the point where manufacture is impractical. This, like #4198 and #4064, was not placed on canister sale until August 1936. Lot #1 was manufactured in July 1935 and in use by the author early in August of that year. It seems to perform much better in the Springfield than the #1147, and the

latter powder was always a favorite with this experimenter.

Du Pont IMR #4227. Introduced in 1935. Still Active 1948. Fine black tubular grains matching IMR #1204, the finest tubular powder ever manufactured in this country. Length .025, diameter .025. This powder is another fine development containing no tin and was formally placed on the market in August 1936. It is designed to replace #1204, which it eventually will do. In heavy loads, particularly in small-capacity cases, #1204 always seemed to be an extremely dirty powder to shoot, according to the author's personal experience with



Three more useful powders to the handloader. Left: Du Pont Bulk Shotgun, an excellent powder for gallery use in revolvers and very light loads in rifles; should be handled carefully in loading; do not use heavy loads. Center: Du Pont Pistol #5, excellent for handgun use only in all charges from mid-range to normal full charge; not suitable for extra-heavy loads. Right: The new Du Pont Pistol #6, rough granulation very similar to Du Pont MX Shotgun; this is the latest handgun powder of Du Pont

it. No. 4227, however, works extremely well for these particular small-capacity cases, and in the Hornet it develops the fine accuracy obtainable with Hercules #2400.

Special Nature of All New Du Pont IMR Powders. The five new Du Pont powders, numbers 4198, 4227, 4064, 4320, and 3031, are straight nitrocellulose progressive-burning types and contain no tin. All these new powders are essentially of the same general composition. Besides the absence of tin they have a specially incorporated flash inhibitor, a distinct forward step in powder development. This particularly dignified-sounding name means that by means of chemical treatment the flash or muzzle blast has been reduced to the minimum possible for any particular loading. This is of extreme importance. A tremendous blast at the muzzle means that a large percentage of the effectiveness of the powder is being wasted. At the same time it is extremely annoying, both to the shooter and to the bystander, and for hunting purposes makes a tremendous concussion which in dry air of the woods is inclined to carry a much greater distance than is wise for successful hunting.

These new powders are slightly more efficient than the old series of powders which they replace. For the same velocity and approximately the same pressure, a slightly lower weight of charge can be used. IMR #4064, #4198 and #3031 all have the same length of grain but of different diameter. IMR #4320 has a shorter-cut grain and a larger diameter than the previous three, whereas IMR #4227 has a still smaller cut and a smaller diameter than any of the others.

Du Pont Pistol #1. Introduced 1914. Discontinued 1915. Black disc grains, diameter .035, thickness .002. This is a powder about which many rumors have been started but none actually finished. Pistol #1 was actually nothing but the old #2 Bullseye as manufactured by Du Pont after the courts assigned all of the old established powders to the new Hercules firm back around 1914. Through some sort of gentlemen's agreement Du Pont was permitted to sell Bullseye under this brand to loading companies under the above name. Much of it was sold to the United States Government, and many shooters will recall .45 ACP cartridges labeled "Du Pont Pistol #1." It was never offered on sale to the general trade, nor was it ever packed in ordinary canisters. It was, of course, a nitroglycerine powder.

RSQ or Resque. Introduced 1909. Discontinued 1911. Manufactured for loading companies and the Government by Du Pont, who also released it in canisters to the general trade. Also manufactured for the Government by the American Powder Mills of Massachusetts. The history of this powder is quite interesting as it served as the stop-gap with the Model 1909 .45 Colt cartridge. In 1909, when the Government adopted the .45 revolver of double-action variety, commercially known as the "Colt New Service," which was generally restricted for use in the Philippines, it developed a new cartridge case with a wider rim so that the extractor would function with certainty. The .45 Colt cartridge, as made for the single-action revolver, had a very narrow rim, while the Model 1909 cartridge is so wide that it cannot be used in single-action revolvers unless the cylinder is staggered with every other chamber loaded. As a gentle hint at this moment, handloaders who have a supply of these old Model 1909 cartridge cases which they desire to reload may use them in single-action revolvers if small slabs are filed from the rims to permit them to enter the cylinder without overlapping.

About this time the Government commenced to have trouble when its loading machines developed

the annoying habit of occasionally dropping two charges (a double charge) of Bullseye into a single case, which usually meant that that was the last shot you fired out of that particular gun. Ordnance experts approached Du Pont (who was then making Bullseye) demanding a new powder, main specifications of which were that it must bulk up so that it would prevent a double charge without overflowing a shell, or so that pressure from a double charge would be so low as to fail to burst the gun. The energetic Du Pont boys hopped to it and played with screenings of Schultz shotgun powders, working the new powder over a bit before trying it out. It did not bulk up sufficiently to absolutely prevent a double charge from entering a case, but it developed pressures from double charges which were much lower than Bullseye. It would not burst the gun on the *first* double shot, but would wreck the cylinder when the second one went off in the same chamber. Those who experimented with Resque during the early days will recall that it was possible to fire six double charges out of a .38 Smith & Wesson Military and Police model and not have anything happen except a loud ringing in the ears. On the seventh shot, however, the cylinder would open up practically every time. The rupture, however, was not nearly as violent or severe as with Bullseye.

The powder worked and was reasonably safe, so the Ordnance boys grabbed at it with the remark to Du Pont that "you folks have certainly rescued us this time." Major K. K. V. Casey (then Captain), with his typical wit, immediately slammed executives of Du Pont with the comment, "Let's call this new powder 'RSQ.'" It was a typical bulk powder with well-formed egg-shaped smooth grains of a soft gray color. Despite the claims of many persons concerning its instability, a canister bearing Lot Numbers 4-849 in the author's possession, manufactured in 1909 and kept sealed in its original canister up to 1935, fails to show any signs of decomposition and performs excellently in loading normal charges for revolvers. There are undoubtedly many canisters of this powder still in the hands of handloaders, and those who have it may use it if it appears to be in good condition, provided they treat it in accordance with the suggestions for the handling of bulk smokeless powder in the following chapter. When the Ordnance Department adopted the Model 1911 Automatic pistol and its cartridge, they abandoned RSQ and returned to the old Bullseye, although it was available in canister form for many years until the supply became exhausted.

Du Pont Pistol #3. Introduced 1913. Discontinued 1921. Flat gray discs, diameter .03, thickness .002. This obsolete Pyro, which was widely used by reloaders some years ago, was long popular. The final lot to be manufactured bore the designation "Lot 1007," and went through the plant in September 1921. Many tons of it were sold to the Government for use in the .45 ACP cartridge. With the standard 230-grain bullet a 6-grain charge produced standard muzzle velocity of 800 f.s.; 8.5 grains in the .45 Colt with the 250-grain lead bullet gave 900 f.s. velocity, a tremendously powerful load, while 5 grains in the .38 Special with the standard 158-grain lead bullet produced a muzzle velocity of 895 f.s. It was a dense powder, and while it proved an excellent number during its lifetime, its successor, #5, was so far superior that it rapidly fell into the discard. It was Du Pont's first "offense" in the line of a dense nitrocellulose pistol powder. Its salesmen had their previously manufactured RSQ, but they found that persons who bought RSQ invariably went back to Bullseye. Du Pont chemists went to work on all existing dense nitrocellulose powders and began reworking, reshredding and regranulating them in experimental lots. The major feature of Pistol #3 was that it gave slightly lighter recoil than Bullseye and bulked up well in the case, thus helping both handloaders and cartridge manufacturers to eliminate double charges. Its chief popularity, however, was with the handloaders, as most cartridge makers have based their specifications on the quaint formula that "number of loads per pound" is the best test of powder when buying it.

Du Pont Pistol #5. Introduced 1920. Discontinued 1940. Flat gray discs, diameter .035, thickness .01. Pistol #5 is a finely granulated nitrocellulose powder intended for use in revolver and pistol cartridges. It has been used in various lots of Government ammunition and to a large extent by ammunition manufacturers. It is one of the best numbers for the handloader, as it will produce reasonable velocities, including those somewhat higher than standard, with safe pressures. It should, however, be handled carefully, as it has a balance point of around 15,000 pounds' pressure, and when used in too heavy a charge is inclined to become erratic. It can be worked successfully in pressures as low as 6000 pounds, and for handguns makes a very successful reduced or mid-range target-load powder suitable for indoor use. It will also work well up to 17,000 and 18,000 pounds and for many years up until 1935 was Du Pont's sole handgun powder. Canisters contain eight ounces.

Hercules Pyro Pistol. Introduced in 1922. Discontinued in 1928. Dirty yellow disc grains, lightly graphited, diameter .04, thickness .005. Pyro Pistol powder, often known as "Hercules 1922 Pyro Pistol" and as "HES 433," was a special powder designed for use in the .45 Automatic pistol and won the 1923 pistol-ammunition tryouts of the Government. Pyro Pistol was a large disc-shaped powder with a grain similar in appearance to Pistol #5, but granulation was nearly twice that thickness. Some ten years ago I used this in various cartridges, particularly in the .38 Special, and was well pleased with its performance. Only limited quantities were placed on the market, and it is rare at this date. Very few so-called "canister data" were obtained with it, and it would be necessary for any user to write Hercules direct, giving his lot number, if he desired loading information.

Du Pont Oval Shotgun. Introduced in 1921. Discontinued 1942. Irregular black discs, diameter .04, length .003. This is very similar to Du Pont Sporting Rifle #93, but the latter was designed for .22 Long Rifle cartridge use and never released to canister trade. Oval Shotgun is a progressive-burning powder designed to give maximum loads in the so-called long-range shot shells. Many reloaders are known to have found that in light charges in rifle cartridges of large capacity it performs well with various bullets, both the lead and jacketed types. Extreme care must be taken, however, in its use, as loading data are not available and it is inclined to be extremely tricky when used at high pressures. Its use is not recommended for rifle or pistol cartridges.

DOUBLE-BASE OR NITROGLYCERINE POWDERS

Hercules Sharpshooter #1. Introduced in 1897. Still Manufactured 1948. Perforated black discs, diameter .075, thickness .017. This is one of the earliest of American nitroglycerine rifle powders and was designed for use in the .45/70 Government cartridge. Originally designed and manufactured by Laflin & Rand, it has been successively manufactured by Du Pont from 1902 to 1914, and by Hercules since that date. It was a fine-grained powder of the dense nitroglycerine type. Containing 40% nitroglycerine when first manufactured, it was tremendously erosive on rifle barrels, although its ballistics were excellent. It was not intended for bottle-neck cartridges, although the powder manufactured by Hercules in recent years is slightly different in formula and performs excellently, particularly with light bullets where there is very little bullet or neck resistance. Sharpshooter is very easy to ignite and extremely accurate in performance. It burns best at around 20,000 pounds pressure, but the tolerance is extremely wide and can be used in loads so very light in rifles that they can hardly be measured on a pressure gauge. At the same time it can be used with loads running as high as 40,000 pounds in cartridges designed to operate at such pressures. It is an excellent mid-range and reduced powder for any of the bottle-neck types of cartridges, regardless of caliber. It is still widely used by ammunition manufacturers in their various Automatic or Self-Loading rifle cartridges. Sharpshooter is the fastest-burning of the entire old line of Hercules nitroglycerine powders.

Hercules Sharpshooter #2. Introduced in 1902. Discontinued in 1914 (?). Black perforated discs, diameter .075, thickness .012. Sharpshooter #2 is almost identical with #1 except in thickness of grain. It was developed by the Du Ponts almost as soon as they took over the Laflin & Rand factory in 1902. Hercules acquired it in 1914. This powder was discontinued by Hercules, and the regular canister grades of Sharpshooter on the market today are known merely under that designation, although they actually are Sharpshooter #1. No. 2 was designed for all cartridges to which #1 was adapted. It was greatly improved when the old Laflin & Rand-Du Pont formula was taken over by Hercules in 1913.

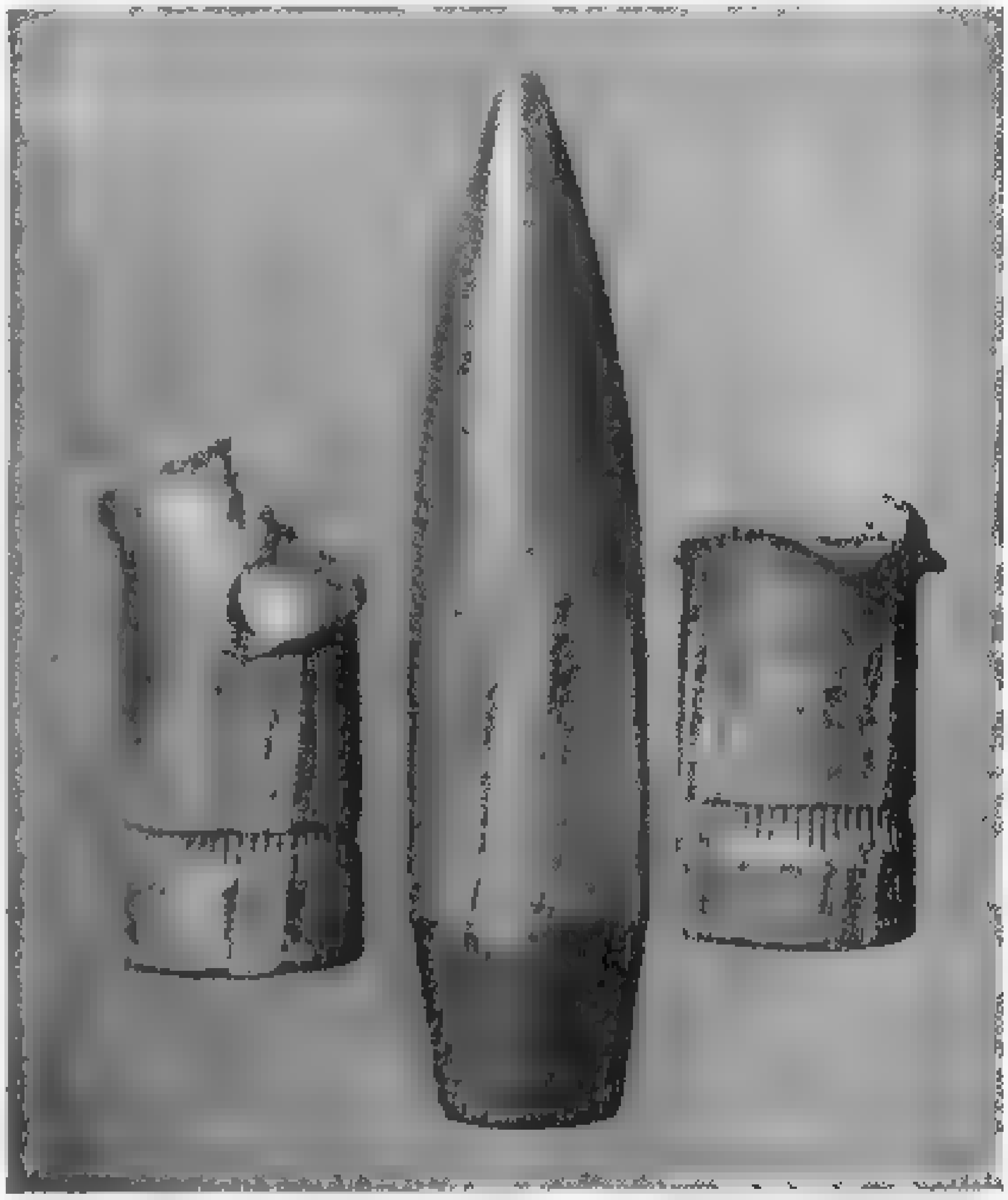
Hercules W.A. .30 Caliber. Introduced in 1898. Discontinued in 1930. Black perforated discs, diameter .08, thickness .045. W.A. powder was named for Whistler and Aspinwall, the chemists who designed it. It contains 30% nitroglycerine. In the early 1900's this powder held all accuracy records in the Krag cartridge, but did not perform as successfully in the Model 1903 or 1906 types (the Model 1903 was almost identical with the Model 1906 except for bullet weight and length of neck of cartridge case). The earlier cartridge used a slightly longer neck and a 220-grain Krag bullet. In 1906 the neck was shortened .06 inch to its present standard and the familiar 150-grain Spitzer or pointed bullet substituted for the round nosed Krag (see reference to Pyro DG). W.A. is not very flexible and burns best at pressures between 35,000 and 40,000 pounds. It is suitable for bottle necks and big-caliber cartridges with long heavy bullets such as the .33 W.C.F. and .35 Winchester. It burns more quickly than the later Hercules development of HiVel but more slowly than either Sharpshooter or Lightning. It is quite erosive on barrels and is not recommended for the reloader if

other powders are available. During the World War much .30/40 Krag ammunition was loaded by commercial manufacturers for the Government, and most of these loads used W.A. powder. Government tests show that barrels have a useful life of not more than 2000 rounds when this powder is employed.

Hercules Lightning #1. Introduced 1899. Still Manufactured 1948. Black perforated discs, diameter .075, thickness .03. Originally a Laflin & Rand development, Lightning went to Du Pont when that firm absorbed the L. & R. outfit in 1902, and changed hands again in 1914 when assigned by Court order to the newly formed Hercules Powder Company. Lightning has been widely criticized by reloaders because of its erosive qualities, but it is an excellent powder from an accuracy standpoint, and much of the criticism of it is unfounded, particularly when it is used with non-corrosive primers. This is a large-grain powder. The grains warp more or less in drying, and while they are of the perforated or "tube" variety, the relation of length to diameter makes them appear to be more like washers than tubes. It is an extremely flexible powder designed for the various hunting cartridges such as .30/30, .303, etc., and is somewhat quicker-burning than either W.A. or HiVel, but slower than Sharpshooter. It is one which burns well under 20,000 pounds and up through the line to 50,000 pounds in cartridges which will handle this pressure. It is an excellent mid-range powder and can be used both with plain-base and gas-checks in addition to the standard metal-jacketed types. It is extremely accurate, requires a low weight of charge to develop velocities, and should be weighed rather than measured because of the shape of grains. It can, of course, be metered out in modern powder measures with reasonable success if no attempt is made to load maximum charges.

Hercules Lightning #2. Introduced in 1903. Discontinued in 1929 (?). Black perforated tubes, diameter .06, thickness .05. This is almost identical with Lightning #1, but the grains are somewhat larger in diameter and considerably thinner. Developed by Du Pont, this powder is now becoming quite rare, as its manufacture was discontinued some time ago. The so-called canisters of "Lightning" on the market today are actually Lightning #1. I have used this powder in the .30/06 with gas-check bullets at low velocities and obtained excellent accuracy.

Hercules Unique. Introduced in 1900. Still Manufactured 1948. Black discs, diameter .06, thickness .005. This is one of the best of the entire Hercules line for mid-range use in the military rifle family or the so-called Sporting Rifle type such as the .30/30, .38/55, etc. This powder is also well adapted to use in revolver cartridges and has for a long time been used by loading companies for this purpose. Unique and Infallible Shotgun are so very similar that the handloader may use them interchangeably for *light and mid-range* rifle and



Tin-containing powders, such as the Du Pont IMR series ending in "½," foul barrels with metallic tin, plating the bullet where it contacts the bore. The above bullets, recovered from a sandbank, include: left, Remington 110-grain fired with charge of IMR #15½; center FA uncannelured 173-grain boat-tail, fifth shot with a powder containing no tin after fouling barrel with ten of the previous loads; right, Remington 110-grain fired with a no-tin powder, tenth shot after one on extreme left. Note traces of tin plating even on this bullet where it contacted the barrel

handgun loadings. Unique can be used at pressures as low as 6000 pounds all the way up through to loads developing 40,000. It is one of the most useful and flexible powders a reloader can have available.

Originally developed by Laflin & Rand, this powder became Du Pont property in 1902 and went to Hercules when the latter firm was formed, as did practically all the other nitroglycerine powders. In old types of cartridge cases, particularly those manufactured a quarter-century ago, it did not prove satisfactory, and many blown primers have been reported. In shells of current manufacture in the .25/20 class it will perform excellently,

particularly in such cartridges as the .25/20 Single Shot. It can be used in revolver loads and for many years has been popular with loading companies, particularly in the use of .38 Special Super-Speed and high-velocity types and "Super-Police" loads with the 200-grain bullet, as it gives higher velocity than standard pistol powders without dangerously increasing pressures.

Hercules Infallible Shotgun. Introduced 1900. Still Manufactured 1948. Black discs, diameter .06, thickness .007. Infallible is one of the earliest of dense shotgun powders designed by Laflin & Rand and later taken over by Du Pont, then turned over to Hercules. The original Laflin & Rand smokeless shotgun powder was an orange-color granulation in discs. It was improved somewhat, the grains graphited and brought out under the name of Infallible. It was for a quarter-century one of the most popular shotgun powders in use and was widely used both by reloaders and loading companies. It can be used much along the lines of Unique, since formula and granulation are nearly identical.

HiVel #1. Introduced in 1908. Discontinued in 1915. Black tubular grains, length .09, diameter .045. This was originally a Du Pont powder and was known as "1908 Military" when manufactured by Du Pont. It was designed exclusively for use in the .30/06 cartridge, but failed to give perfect satisfaction; hence its discontinuance shortly after the Hercules Powder Company was formed.

HiVel #2. Introduced in 1908. Still Manufactured 1948. Black tubular grains, length .090, diameter .04. HiVel #2 is a double-base powder with about 15% of nitroglycerine. It is the slowest-burning of the Hercules double-base powders. HiVel #2 is one of the most popular members of the entire Hercules family, and will burn excellently at pressures up to more than 50,000 pounds and well below 20,000. It can be used in most of the bottle-neck cartridges but was designed primarily for use in the .30/06 and other military types. It gives a lower pressure at a given velocity than nitrocellulose powders, leaves very little residue, and requires a much lower charge. It has been asserted by some authorities that HiVel is highly erosive, but it is believed that this statement

Thirty-five different kinds of rifle powders used by the author in his handloading. Eight others have been added to the above list since the photo was taken

is in error. Despite the fact that it has a greater potential, this powder requires a much lower weight of charge to develop equal velocities, and this, together with lower pressure, more than offsets the combustion temperature. HiVel can be measured, but it is none too successful on this score because of its large grain size. HiVel #2, although long declared to be suitable only for metal-jacketed bullets, has been tested by the writer, who used both gas checks and plain lead bullets, the latter, of course, in light loads. In the .30/06 cartridge using a 230-grain lead bullet cast 1 to 15, a muzzle velocity of 1470 f.s. is obtained with 22 grains at a pressure of only 16,700 pounds. This load performs excellently up to 100 yards. With the 167-grain gas check, 27.4 grains give a muzzle velocity of 1800 f.s. with a pressure of 20,000 pounds. With the same bullet, 45.2 grains will drive the gas-check bullet up to 2600 f.s. at a pressure of 41,500. This load has been used by the writer with extreme success at 100 yards and is among the loads recommended by the Hercules Experimental Station, thereby shattering the old

theory that gas-check bullets could not be driven over 1800 to 2000 f.s. In the .300 Savage the same bullet with 15 grains is given a velocity of 1100 f.s. with pressures in the vicinity of 12,000 pounds, again disproving the statement of some persons to the effect that this powder could not be used in very low charges.

Hercules HiVel #3. Introduced in 1926. Discontinued 1940. Black tubular grains, length .080, diameter .035. This is one of the newest members of the Hercules family. Although first produced in 1926, it was not released to the canister trade until early in the summer of 1935. It is slightly smaller in granulation than HiVel #2, runs reasonably well through the average powder measure and is superbly accurate and flexible. In the .300 Savage a charge as low as 10 grains can be used behind a 154-grain plain lead-base bullet developing a velocity of 1180 f.s. and a pressure too low to register. A charge of 16 grains with the same bullet gives a velocity of 1460 f.s. with a pressure of only 8400. By the same token, it operates excellently at pressures as high as 50,000 pounds or more, and in the .300 Savage with the 180-grain .30/06 bullet, 31.5 grains give a muzzle velocity of 2420 with a pressure of 49,000 pounds. HiVel #3 is superbly accurate and will work with practically every bullet weight in the .30/06 and .300 Savage, and in similar cartridges running from the 80-grain .32/20 up to 200-grain types.

HiVel #6. Introduced in 1933. Discontinued 1941. A new powder designed for the .30/06 cartridge. This powder is not available to the reloader at the present. Very few data are available on it, except that it achieves extremely high velocities with heavy bullets within the permissible pressure limits of this cartridge.

Hercules 1908 Bear. Introduced in 1908. Still Manufactured in 1948. Black tubular grains, length .052, diameter .034. Although this powder was never sold in canister lots to reloaders, it is mentioned briefly here, since small quantities of it may be available to handloaders. It was designed for sale to loading companies primarily for use in such cartridges as the .351 Winchester self-loading, .401 W.S.L., .25/20 and .32/20, the latter primarily in the so-called "High Speed" loads. It was a double-base powder very similar in appearance to Du Pont IMR #18. This was one of the old Du Pont powders inherited by the Hercules Powder Company when the latter firm was organized.

Hercules 1908 Stag. Introduced in 1908. Discontinued in 1914. Black tubular grains, length .045, diameter .035. This was a powder very similar to 1908 Bear and was intended for a similar line of cartridges. It was never sold in canister lots and was one of the powders inherited by Hercules from Du Pont.

Hercules Bullseye #1 and #2. Introduced in 1898. Still Manufactured 1948. Black discs, diameter .034, thickness .003. This is the oldest handgun powder on the American market. It was first produced by Laflin & Rand and met with immediate success. It is the standard of the United States Government and of all ammunition factories for various pistol cartridges. Bullseye is a fine-grained thin-disc type of powder of extremely quick-burning qualities. It will burn in revolvers having a barrel length as short as two inches and equally well in six- or eight-inch target barrels. It can be used in most low-charge gallery loads or standard loads, but is unsuited, because of its quick-burning qualities, for high-velocity or Magnum-type loadings. It meters excellently in any of the standard types of gravity-feed powder measures but is lacking primarily in bulk, as in most handgun cartridge cases it does not by any means fill the case and care must be taken to prevent double charges being thrown.

"Bullseye," as it is generally known, or "Bullseye #2," as it is officially known, began its existence when Laflin & Rand developed the first Bullseye made from "sweepings" of Infallible Shotgun Smokeless. It was jokingly said that they swept up the plant regularly to get Bullseye revolver powder. As a matter of fact, these so-called "sweepings" are what is better known technically as "screenings." They were, of course, of irregular granulation and for the most part fine partial cuttings of the larger powders. It took a small pinch or two to develop a charge equal to normal black powder in a revolver cartridge, and twice that amount usually meant that the revolver was retired from active service. When this original Bullseye or Bullseye #1 came out, it went over like wildfire both among ammunition manufacturers and in the handloading clan. The boys began playing with it and blew up a few handguns, but they invariably traced the wrecks to their own carelessness.

About the time that the Du Ponts inherited the plant through the absorption of Laflin & Rand in 1902, they found that there were by no means enough screenings available to fill the growing demand for Bullseye, as it had been accepted at that time by Frankford Arsenal and various loading companies as *the* thing in the smokeless powder family. Du Pont therefore set to work to manufacture some special powder for loading-company use, developing the smallest possible grain diameter and cutting the strings into as thin flakes as me-

chanical ingenuity would permit. The result was an extremely small round disc which bulked up somewhat better than the original Bullseye, took a slightly heavier charge, and began not only to sell to loading companies but also to the handloading family in canister lots. This became known as Bullseye #2, and the original Bullseye from that time on was called "Bullseye #1." The exact date of development of this #2 Bullseye is somewhat in doubt—probably around 1904. It can be used in very small charges in rifle cartridges if the muzzle of the gun is elevated for each shot, particularly when used with round balls or buckshot. This is advised against, however, as there are many other powders available which are far more satisfactory for this purpose.

Hercules #2400. Introduced in 1932. Still Manufactured 1948. Black discs, diameter .03, thickness .012. Although brought out in 1932, this powder was not released to the reloaders or canister trade until 1933. It is a very fine-grained dense type, similar in composition to HiVel. It is quick-burning and for that reason is one of the most flexible powders in the Hercules line. It can be used in revolver cartridges to obtain high velocity, yet in the same cartridges it can be used for mid-range indoor target loads. It was designed particularly for such cartridges as the .22 Hornet, .25/20, etc., and here it is at its best. However, it can also be used for both full charge and reduced loads in cartridges as large as the .30/06. The tabulations of loading data elsewhere in this book list the use of #2400 in more than 30 different cartridges. It can be used in the .30/06 with an 80-grain .32/20 hollow-point bullet, and in this cartridge 26 grains give a muzzle velocity of 2500 f.s. with a pressure well below 20,000 pounds. By the same token, 43.4 grains give a muzzle velocity of 3600 f.s. with 51,000 pounds. With a gas-check bullet, velocities in the vicinity of 2000 f.s. give excellent accuracy. It can even be used with the 220-grain bullet in this cartridge, 14 grains giving a muzzle velocity of 1180 with below 20,000 pounds pressure, while 33.6 grains give a muzzle velocity of 2170 with 51,000 pounds pressure. In handgun cartridges it has made possible a great many Magnum loads not previously possible with any other pistol or rifle powders.

Hercules Red Dot. Introduced in 1932. Still Manufactured 1948. Canister lot, disc-shaped grains, diameter .06, thickness .004. This is a dense semi-progressive-burning double-base shotgun powder intended for standard or normal charges. Although manufactured in several different grades or rates of burning, only one of these is available to the canister trade. It can be used successfully in handgun cartridges and in light loads in military rifle cartridges. Red Dot powder is essentially a flat disc-shaped grain, some grades of which have perforations through the center. Essentially, the grains are of the typical black graphite color, although scattered throughout the mass one finds a certain number of these grains which have been colored a bright red—hence the name "Red Dot."

Du Pont Ballistite. Introduced in 1909 (?). Discontinued 1939 (?). Square black flakes, width .05, thickness .005. This powder is very similar in formula to Hercules Infallible. Essentially a dense shotgun powder, it can be used in certain revolver cartridges having large bores and straight cases, although it is not generally recommended. It is a square or "flake" type of powder long popular with shotgun shooters. For many years the Peters Cartridge Company has used this powder in loading the .45 ACP Thompson Riot shot cartridge intended for use in the sub-machine gun.

MULTI-BASE POWDERS

Du Pont MX Shotgun. Introduced in 1933. Still Manufactured 1948. Irregular greenish-black chip granulation. A dense multi-base shotgun powder designed for superior performance with standard loads. It is made in seven or eight different grades or rates of burning and sold thus to meet the requirements of various shot-shell manufacturers. One grade only is made for canister consumption, known as "MX Shotgun." It performs reasonably well in revolver cartridges, but its use is not recommended for this purpose.

Du Pont Pistol #6. Introduced in 1933. Still Manufactured 1948. This is another multi-base powder which the writer has been using in various handgun cartridges since the latter part of 1933, although it was not made available to reloaders in canister lots until the summer of 1935. It has a granular structure very similar to MX and probably resulted from experiments with MX Shotgun powders in handgun loadings. It bulks up excellently and handles nicely through powder measures, filling a cartridge case much better than the old Pistol #5. At the same time it requires a grain or two less in weight than #5 to get the same ballistic results and is more accurate in shooting and cleaner in burning. It will undoubtedly make a name for itself within the next few years, and may force the discontinuance of the old familiar standby—Pistol #5—although tremendous quantities of #5 will be available for many years to come.

XIX

STORAGE, TRANSPORTATION, AND HANDLING OF POWDERS

THERE are a great many things to this handloading game which slip the attention of the beginner. He merely accumulates tools, a can or two of powder, and then goes ahead in an effort to secure good results. He finds that instead of quitting the game after a few months, he continues on throughout the years. He buys and accumulates more and more different powders, experimenting with loads, recording the results, and doing the job over as it strikes his fancy; and then he begins to realize that the care and storage of powder is a problem worthy of real consideration.

For some peculiar reason, the true inwardness of which I have never been able to discover, smokeless powder has been banned from the United States mails ever since the beginning of its history. It was long banned from normal express shipments as well, but today it may travel by express. In storage, smokeless powder is by no means any more dangerous than articles of celluloid, including films. Paints are more dangerous than powder. Most foreign countries permit the mailing of powder in special metal or pasteboard tubes, and in Germany in particular, powder is packed in two different ways—canisters or kegs for store sales, and heavy cardboard tubing for mailing purposes. It seems that in the early days of smokeless powder, trouble was derived from decomposition, but this problem has been entirely eliminated for the past twenty years.

If you desire to abide strictly by the law, it would be well to check up your local city or town ordinances covering the subject. Many cities bar the storage of powders either in stores or private dwellings, and this is a point well worth looking up. Ten pounds of smokeless powder, if ignited during a blaze which destroys or partially destroys a dwelling, will not create the slightest trace of explosion; but it will intensify the blaze for a short period. Celluloid toys, combs and similar articles will burn fully as furiously and accelerate the fire fully as much. Films, either exposed or unexposed, are even more deadly in storage in case of fire. They are inclined to give off obnoxious fumes and dense smoke in burning, and yet you can store a thousand dollars' worth of films in your house without a permit. Most cities also fail to have ordinances controlling the storage in normal quantities of gasoline, benzine, naphtha, and many similar cleaning fluids within a private dwelling, yet a quart of gasoline stored in a gallon can, in case of fire, will not burn —it will explode!

Regardless of your opinion of the local ordinance controlling the storage of smokeless powder, it is well to bear in mind that if you disobey this ordinance, have any form of conflagration in your property, and then endeavor to collect insurance, the insurance company may void your policy if it learns that you had powder on hand, even though the powder had nothing to do whatever with the fire and even happened to be in a portion of the house which was not burned. Bear that in mind.

A quarter-century ago some of the early smokeless powders began to deteriorate in storage. They did not explode, but they created fire through spontaneous combustion. Accordingly, it is well to examine your supply of powder at frequent intervals to determine if any has begun to deteriorate. Examine carefully any canister that shows signs of rusting. There is a reason for that rust. If it is caused by atmospheric conditions, see that they are corrected. If it is caused by deterioration of powder, *destroy that lot of powder immediately!* Do not attempt to save or use any portion of it. Deteriorating powder may or may not be safe to use in a gun. Generally speaking, if powder deteriorates it loses its strength, and numerous Government tests of deteriorated powders are in the author's files to bear this out. Occasionally, however, deterioration causes just the opposite effect, and a small quantity of powder is not worth saving if it is endangering the shooter's eyesight or one of his pet guns.

Wherever possible, keep your powder in the original container or canister. Many powder canisters come through without a cork stopper within the tin cover. To remove this cover, you must, of course, break the seal, but it is well to do so as soon as you receive your canister. If it has a thin sheet of cork in the canister top, screw it down tightly and lay the canister aside; if not, make a cork seal. Always date your canisters on the label indicating when purchased and where. Some canisters have

a lot number. Be sure that the lot number remains intact. Du Pont formerly placed a lot number on a strip of paper pasted to the bottom of the canister. This frequently came off and was accidentally lost. It is wise to recopy the lot numbers on the label in ink. When the labels of your canister show signs of dropping off or are badly damaged, remove them and make new ones. The most successful label is a strip, one or two inches wide, of ordinary medicinal adhesive tape. A new kind of tape recently brought out by Bauer & Black and similar companies is waterproof and smooth. Any adhesive tape will stick solidly to a tin can and remain there throughout the years. Waterproof drawing ink is the best for inscribing the necessary data. Do not use a pencil. Do not attempt to paste ordinary paper labels to your tin with mucilage, glue or other material, or use so-called "gummed labels." They will not stick, and you will merely have unlabeled cans which in many cases cannot be identified because of the great similarity of different powders. Take no chances. Rubber cement successfully holds torn labels on tin containers.

Inspect your powder at regular intervals. If a copper funnel is kept available, it is a very simple matter to pour your powder into a clean pasteboard box or box cover, inspect it for signs of deterioration or débris, and then pour it back into its canister.

Another mistake made by many handloaders is the determination of the contents of a canister through the age-old process of shaking the can. Don't do it! Nitroglycerine powders, if they begin to show signs of deterioration through improper storage or improper manufacture, may sweat out tiny globules of pure nitroglycerine. To shake a canister containing powder in this condition is to invite sudden and complete destruction, as nitroglycerine—ever since its discovery—has been extremely bashful about shaking. Bulk powders, too, are dangerous to shake, since many of them are very soft-grained and the shaking creates an abrasive action which still further reduces grain size.

Many handloaders from time to time acquire large lots of defective military ammunition. This kind of ammunition is particularly liable to show up now as a survival of the World War period. The average wartime cartridge will be split at the neck, although many lots are still capable of delivering perfect results. It is not wise to use split-neck cartridges; although they can be shot with reasonable safety, the gas leakage is destructive to your chamber, particularly in the throat and neck. Accordingly, the shooting fan who secures a case or so of this defective fodder proceeds to pull it down, salvaging bullets and powder but rejecting the cases. If he rejects cases, he should also reject primers, as it is impossible to decap a primer and use it again without seriously damaging its ignition qualities. This is discussed in more detail in the chapter on primers.

Most salvaged powders can readily be identified if the owner cares to check up on the packing slips or other data contained within the case from which they were obtained. Military ammunition is usually packed in bandoliers, with each bandolier containing a small slip or cardboard giving facts concerning its loading and ballistics. Match and other cartridges which are not packed in clips usually have the necessary data imprinted on the label of the box. Even if kind of powder is not listed, the handloader can check with the manufacturer to determine the type of powder and proper charge used in his particular lot-number of cartridges.

Before that salvaged powder can be used, it should be thoroughly screened, inspected and blended. A case of 1200 rounds of wartime Springfield ammunition if broken down for powder purposes will net at least eight pounds of powder, which is probably Du Pont #20 or Pyro DG. Since most wartime cartridges are waterproofed, the handloader will find in his bulk supply of powder a large amount of tiny pieces of dried shellac. This may take the form of rings, since the inside of the case neck is frequently shellacked before the insertion of the bullet, thus forming a ring on the base of the bullet which in time chips off and falls into the case to mix with the powder charge. This ring may come out in one piece or may be broken into a number of sections. At any rate, it should be removed, and screening and blending will take care of this.

The bulk of these large pieces may be removed through the simple method of pouring the powder through a sieve made of fine wire netting such as is used for window screens. The larger pieces will collect on this. If an electric fan is available, it can be used to very good advantage to remove dust and tiny particles of powder during the pouring process. The powder is poured from one receptacle to another from a height of at least a foot, with a gentle breeze from an electric fan blowing in the direction of the powder stream. This is a delicate operation. If the fan is too close, it will blow your powder grains all over the room. Some persons like to remove the dust and shellac flakes by blowing on it with the breath, but with some eight pounds to be cleaned, the handloader soon

finds that his reserve supply of wind is depleted in an astonishingly short time. Also, he must take extreme care. If he is too energetic in his blowing, he is liable to find it necessary to put some of his supply of powder through a washing and drying process.

A still better way to remove these tiny flakes of shellac and other foreign matter is to build a trough at least a foot long out of heavy white bond letter-paper. The trough should be built curved rather than of the "V"-bottom type, and should be propped up through the ingenuity of the handloader in such a position that both hands are free. The powder is poured into one end of the trough, which has sufficient incline to permit it to flow readily but not too rapidly into an additional receptacle at the opposite end. The operator pours the powder from some cup, canister, bottle or receptacle held in the left hand, and with a small dry syringe or rubber bulb held in the right hand and operated rapidly, a stream of air is directed about two-thirds of the way to the bottom of the slowly flowing powder stream. The tiny fragments of débris are then blown out, as is the surplus of loose graphite shed by the powder grains during storage either in canisters or in the cartridge case. This process is usually repeated two or three times to make sure that the powder is absolutely clean, whereupon it is ready for the blending.

Blending is really a rather simple process. One merely uses some sort of large receptacle. A good clean porcelain bowl or agateware dishpan is ideal for this purpose. The powder is poured from canisters, boxes or cups into the receptacle, always in the same spot, so that it forms a conical pile, the top grains running down the side of the growing heap. When the entire batch is poured into the dish, the operator gently stirs the pile and then repeats the mix-pour process. This is done several times, whereupon the powder is thoroughly blended and may be stored in canisters, bottles or fruit jars. Be sure that it is labeled. Incidentally, for this purpose you will find it convenient to save all empty powder canisters, as they may be used quite successfully through the removal of labels.

The most important subject of powder blending concerns the bulk powders such as Du Pont Smokeless Shotgun, Empire, E. C., Gallery #75, S. R. #80, #1 Rifle, and Schuetzen. No. 1 Rifle and Schuetzen are particularly friable powders (which is to say, the grains will crush in storage). It is well to bear in mind that the finer the granulation of a given powder, the greater the velocity and pressure developed with the same weight of charge. Velocity, however, increases but slightly in comparison to pressure. Very fine grains of any bulk powder can seriously affect the shooting and even on occasion may blow up a gun.

Du Pont Smokeless Shotgun is not quite as friable as some of the others, but it has a tremendous variation in grain size. This also applies to Schuetzen and E. C. If you have a canister, empty it into a dish and notice the tendency of fine grains of powder to collect together in spots while the coarser granulation moves over to group up in an entirely different part of the mixture. Notice, also, in your pouring, that a fine dust arises, said dust being the direct result of abrasion in storage, as this must all be screened out before the lot of powder is considered "completed."

Bulk powders, since they are much lighter in bulk than the hard or dense-grain rifle powders, must be treated carefully to remove the dust. Fine screen wire is quite successful. This screening or wire gauze can be obtained from a great many sources. A good material for screening this fine dust from bulk powder is ordinary fine-mesh gauze such as is used for straining gasoline. A gentle breeze should be blown on it from an electric fan or hand syringe; but if possible avoid using the breath, as these powders will absorb moisture to an alarming degree. Before using the powders, blend thoroughly through the pouring process to prevent running assorted granulations into your cartridges when feeding through a powder measure. It is well to empty the hopper of the powder measure at frequent intervals and to refill it with a properly blended lot. If this process is followed carefully, more uniform loadings will result.

Canisters of powder should be stored where they will be away from inspection of inquiring friends who like to perform experiments of shaking canisters, pouring out samples in the hand for examination, and pouring said samples back in again after much mauling in the fingers. Many handloaders prefer to keep only a single canister of a given kind in their handloading room if they use this room frequently. Cellars may be used for the storage of the balance of the powder if they are naturally dry. If your cellar is damp, by no means permit the storage of your powder there, as the dampness is certain to damage the powder or the canister containing it. A clean dry attic is usually the best place for storage, but here again one runs into the problem of heat. With certain bulk powders, storage in the summertime beneath a hot attic roof may increase their strength alarmingly through the evaporation of normal moisture in the powder.

By all means use some form of powder chest

kept under lock and key. Any wooden chest will do, the larger the better. Canisters should be stored upright, if possible, rather than on their sides; and do not tell your friends and neighbors the exact quantity of powder you have around. It may prove embarrassing if some city official who through ignorance does not understand the problems of the handloader decides that two or three different kinds of powder are altogether too much to be permitted in his territory. Keep your reserve supply of powder properly protected; and it is well to have a good reserve supply at all times.

Until early 1936, it was impossible for the average handloader to move powder by express. The Interstate Commerce Commission had ruled that smokeless powders were "high explosives" and thus dangerous to transport—too dangerous to permit being moved on a passenger train. Powders could be moved under special permit when properly packaged and labeled with a special red label marked "Explosive—Sample for Laboratory Examination." The specifications called for packing in canisters containing not over eight ounces each, and in shipments totaling not over five pounds. These canisters must be packed in a wood box, which must, in turn, be packed in another wood box, the inner box being separated from the outer by a minimum of four inches of closely packed sawdust, excelsior or shavings. It was impossible to ship to other than recognized laboratories because of these restrictions.

I recall with great satisfaction a shipment received from Du Pont one morning when a certain inspector who may read these lines happened to be present as the red-labeled shipment arrived. I called to pick it up, as I had outgoing material that morning, and the inspector, after making derogatory remarks about powder companies, insisted on an inspection. I assume that he was within his rights. The shipment was solidly packed, and, armed only with a screwdriver, the inspector proceeded with his task. I insisted that he be careful not to break or damage a single board, as they were all desired for something or other.

It took that inspector an hour to unpack the shipment, as he had the constant supervision of the consignee and some half-dozen Railway Express Agency employees. When he found the contents in order, he was ready to quit; but we questioned his legal right to leave a package in that condition and demanded that it be packed and sealed as he found it. That *was* a task, requiring more time than the unpacking. That inspector learned much during his forenoon of labor.

At last, however, the ban on express shipments of smokeless powders has been lifted. Through the efforts of H. S. Harper of Belding & Mull, the Interstate Commerce Commission, under date of December 10, 1935, ruled that on and after March 20, 1936, all express companies might handle shipments of powders when packed as specified. The new packing specifications are ICC Class 15C. Shipments may total 10 pounds if packed in one-pound cans in an ordinary wood box. No packing material is necessary if the canisters fill the container, but the outside box must be labeled "Smokeless Powder for Small Arms." Such a shipment takes normal first-class rates. So far as the handloader is concerned, this new ruling is the most important development since the World War. Previously powder had to be shipped by freight at double the first-class rates—and freight rates are based on a minimum of 100 pounds. Even with shipments by express, however, it is well to purchase in as large quantities as practicable. It will cost less per pound when a quantity is ordered, and many handloaders living in one vicinity may pool their orders for a single shipment.

In the Appendix of this volume will be found a list of dealers and powder magazines handling Du Pont and Hercules smokeless small-arms powders. Order from the one nearest you, or if in doubt, write Du Pont and Hercules, both firms at their Wilmington, Delaware, offices, requesting the location of their nearest distributing center.

Smokeless powder is also barred from the luggage of individuals on trains, buses, steamboats, ferries or other duly authorized common carriers. Transportation in this manner is punishable by heavy fines. You may, however, transport it to your heart's content in your own auto or truck. But a car containing even a single canister of smokeless powder cannot legally be stored in a public garage.

The average handloader does not appreciate these facts of shipping, storage and handling. There are practically no restrictions on gasoline, yet a concrete instance comes to my mind as this is being written. A few years ago a junk-store owner had a serious explosion, which completely wrecked the interior of his somewhat decrepit store, blowing out his plate-glass windows and doing similar damage throughout the block, including that done to the windows of a large factory on the opposite side of the street. The man was accused of causing the explosion when it was revealed that at this time he had been breaking down a few hundred .38 revolver cartridges which had become water-logged during a sporting-goods store

fire and had accordingly been condemned and sold as junk. The junk man had been pulling the lead bullets, destroying the powder by pouring it into the sewer and salvaging the scrap lead and empty brass cases. Authorities accused him of thus creating the explosion, and I was called in to investigate the matter.

There had been an explosion but no serious fire, the fire damage amounting only to a scant few dollars. Investigation soon revealed that in the front room of the shop was a small barrel stove in which a brisk fire was going, because of near-zero temperatures outside at that time. The stove was backed up against a light beaverboard partition which separated the front of the store from the shop. On the opposite side of the partition was a five-gallon can which the owner claimed never held more than "a quart or two of gasoline," and which was used solely to clean his hands after working on old junk. There is nothing more dangerous. The heat had filled that five-gallon can from its small quantity of gasoline with a tremendously explosive vapor. Possibly a portion of this leaked out through a poorly sealed cap and became ignited. It was definitely proved from the condition of the can that therein was the source of the explosion. Spilled powder from the breakdown of cartridges was scattered over the floor but hardly any of it had burned, yet authorities, including an insurance company and its crew of trained investigators, detectives, et al., had accused this man of creating the explosion with gunpowder.

The author recalls quite vividly an explosion case in which he was called upon to give court testimony. In an effort to prove that Du Pont Military Rifle powder #20 was non-explosive, he poured about two ounces into a saucer and was about to touch a match to it in the courtroom. There was a general rush to take said match away from the witness and in the meantime everyone evacuated the courtroom—including the judge! The test was conducted a few moments later in the judge's private chambers, but even then the Honorable Court felt that he was being hoodwinked when the powder burned with a soft celluloid-like hiss instead of a tremendous explosion and a detonation which he suspected (and rather hoped) would maim, mutilate and totally destroy said witness. After becoming privately convinced the judge permitted the test to be repeated before the jury, although the jury was extremely anxious to retire before the test was conducted. A single ounce of black powder, however, when ignited in a dish, is quite startling to all parties concerned. The uninitiated—and probably the Interstate Commerce Commission—remembering this fact, undoubtedly felt that smokeless powder, being many times more "powerful" than black powder, must be even more dangerous under such a test. I would hate to know that there were ten pounds of black powder in canisters in my home during a minor fire, although I would not be in the slightest disturbed over the storage of an equal amount of smokeless.

The handling, loading and storage of black and Lesmok powders, including of course King's Semi-smokeless, present a problem requiring extreme care. These powders are more dangerous than smokeless. The canisters should never be shaken; they should never be handled during a thunderstorm or in the wintertime when the air is filled with static electricity. The handloader should always touch some heavy metal object some distance from the canister before reaching out for it that he may safely discharge any static electricity contained in his body. Accidents from this source are very rare *but have been reported.* The unfortunate part of it is, the man who has these minor accidents rarely reports them. He prefers to keep quiet and "live it down." Handle and store your powder properly and it will perform perfectly throughout your lifetime. The better grades of powder and practically all dense rifle powders, particularly those manufactured within the last ten years or so, appear to be permanently stable. Samples of nitroglycerine powders manufactured about the year 1900 are today as good ballistically as on the day of their manufacture. The same is true of Du Pont Smokeless Shotgun and a number of other powders which have been properly stored.

XX

POWDER BALANCES AND SCALES

PERHAPS the most delicate instrument in the handloader's entire line of tools and accessories is his powder balance. This instrument is not as thoroughly understood as many persons seem to believe. Furthermore, it can stand very little abuse without losing its sensitivity. Various catalogs use a mixed assortment of terms rather improperly in describing the performance of various scales or balances. They refer to the "instrument's "sensitivity," "sensibility," or "accuracy," interchanging these terms indiscriminately. There *is* a difference.

It is incorrect to refer to the "accuracy" of a balance. A balance is not "accurate"—it is "sensitive." On the other hand, the weights used with the balance are not "sensitive"—they are "accurate." The degree of accuracy will vary tremendously in weights, but on the better quality of these very necessary accessories the manufacturers specify certain classes of Bureau of Standards specifications.

No powder measure yet devised—and that includes the complicated machine-measuring devices in use at the various arms and ammunition manufacturing establishments—can compare with the precision *possible* in the assembling of handloads. Powder charges in factory ammunition will vary far more than is generally believed. I have unloaded many assortments of current ammunition and in a given box have found in ten cartridges a variation of at least 1.5 grains in handgun loads, and as much as 3 or 4 grains in military rifle calibers. As a rule, however, machine-loaded ammunition will vary less than a grain on handgun loads and less than 2 grains in the military rifle class.

Even our famous Frankford Arsenal excellent Mark I ammunition will vary in certain batches and with certain powder as much as 3 grains in weight. The average shooter, even for match work, is not bothered by inaccurate ammunition because of these variations, but for long-range target work of from 800 to 1000 yards, greatly increased performance can often be obtained by pulling these bullets, weighing the charges, resizing the shell necks, and reseating the bullets.

It must be understood, however, that while machine-loaded ammunition will vary slightly in powder charges, there are so many other factors of uniformity which control the group possibilities of a particular lot of ammunition that precision handloads have to work hard to keep up with the general run of factory stuff. This includes, of course, the uniform seating of primers, crimping of bullets, etc., in factory ammunition—matters discussed elsewhere in the chapter on priming and bullet seating. If precision handloads are assembled with attention to detail in the choice and preparation of all components, including the weighing of powder charges, no machine-loaded ammunition of equal ballistics can possibly compare with the handloaded from an accuracy standpoint.

It has long been an accepted custom among handloaders that all powder charges should be held to 1/10 grain variation. This is absolutely correct if the best of results are to be obtained. It is possible, as a rule, to be as accurate as this when using several of the many powder measures on the market with certain granulations of powders; but a powder measure contains a very large element of *human error* which is added to the mechanical error of the measure; *accordingly this writer does not recommend the measuring of any maximum rifle or handgun charges or any other precision load closely approaching a maximum pressure.*

What then should one use for a powder balance?

Best Powder Balances. A good sensitive balance is an expensive piece of equipment. It is impossible to turn out a true precision instrument of this type at a low price, owing to the necessity for much handwork in its manufacture.

There are two essentially different types of instrument used for weighing powder. One is the overhead-beam type of construction, better known as a "balance," in which a beam having a fulcrum point at its center suspends a pair of balanced pans from opposite ends of the beam and maintains a vertical pointer at its center. This pointer indicates—on a small lined-off scale or "index," as it is technically called—exactly when the pans are balanced. When this occurs, they hang with the needle pointing at the center or zero mark. In use, this balance has certain definite combinations of weights placed in one pan and the ingredients to be weighed inserted gradually in the other, until one

balances the other with the needle resting exactly at zero.

The other form is better known as "scales." It, too, maintains a fulcrum point, but the beam serves as a pointer with some means of indicating when it is in balance on its opposite end. The materials to be weighed are inserted in some form of pan suspended at one end of the beam to balance. This type of instrument is rarely as sensitive as the true balance and usually does not cost nearly as much. Scales of the "spring" type, such as are used in crude forms of weighing, are not manufactured for delicate work and accordingly will not be discussed here.

The true balance suitable for reloading not only suspends the beam on "knives" but at either end one may usually find an "upside-down" knife fitting into some form of bearing which supports the pan hangers. These knives must always register perfectly in their bearings, as any jar which would throw them off side, would give a false reading on the index. On most of the lower- and medium-priced balances, these knives fit into a V-shaped bearing. In other types, they operate on "planes" or surfaces ground absolutely true and flat. These plane bearings require an additional form of guide to control the exact location of the knife on the plane. It is not necessary to describe the various methods, as these are more or less manufacturer's ideas and one invariably works as well as another.

Looking back at the foregoing description, the handloader will readily see that the maintenance of the sensitivity of his balance depends entirely upon keeping that instrument free from oil, grease or dust, which would cause its action to become sluggish in the critical points around the knives and bearings. The instrument must be mounted on some solid object so that it is free from vibration and shock. At the same time the legs of the cabinet or drawer are most effectively supported if they are inserted in rubber-bottomed glass cups —similar to the old-style glass cups used beneath the legs of a stove.

If these cups are not available, suitable shock-proof leg supports can be manufactured out of small inch discs of hardwood, properly hollowed out to take the screw legs of the cabinet. Further protection can be assured the delicate knives if the bottom of the supporting blocks is covered with a quarter-inch layer of soft rubber. If one lives in or near a large city, it is a simple matter to obtain a section of a heavy-duty truck-tire inner tube which can be cemented to the bottom of the blocks or cups. This not only minimizes vibration damage to the knives, but also makes the balance more or less skid-proof. Your balance knives must be protected at all costs—they are the critical point in the sensitivity of the balance. If they become dulled—and that only takes an instant with mistreatment—your balance will no longer enable you to produce the accurate loads you desire. Furthermore, the sharpening of these knives *cannot be accomplished by hand;* should they be accidentally dulled, the instrument should be carefully dismantled, packed and shipped to the factory for the resharpening process. Not only must these knives be absolutely sharp, they must also be *perfectly true* in relation to their bearings. Any attempt at handwork at home, even with the finest

An excellent little scoop for running powder into the pans of your balance. This scoop was made from a new .30/06 shell. New cases work better for this, since the interior is clean and bright. The handle is a short brass rod which also serves as a plug in the primer flash hole

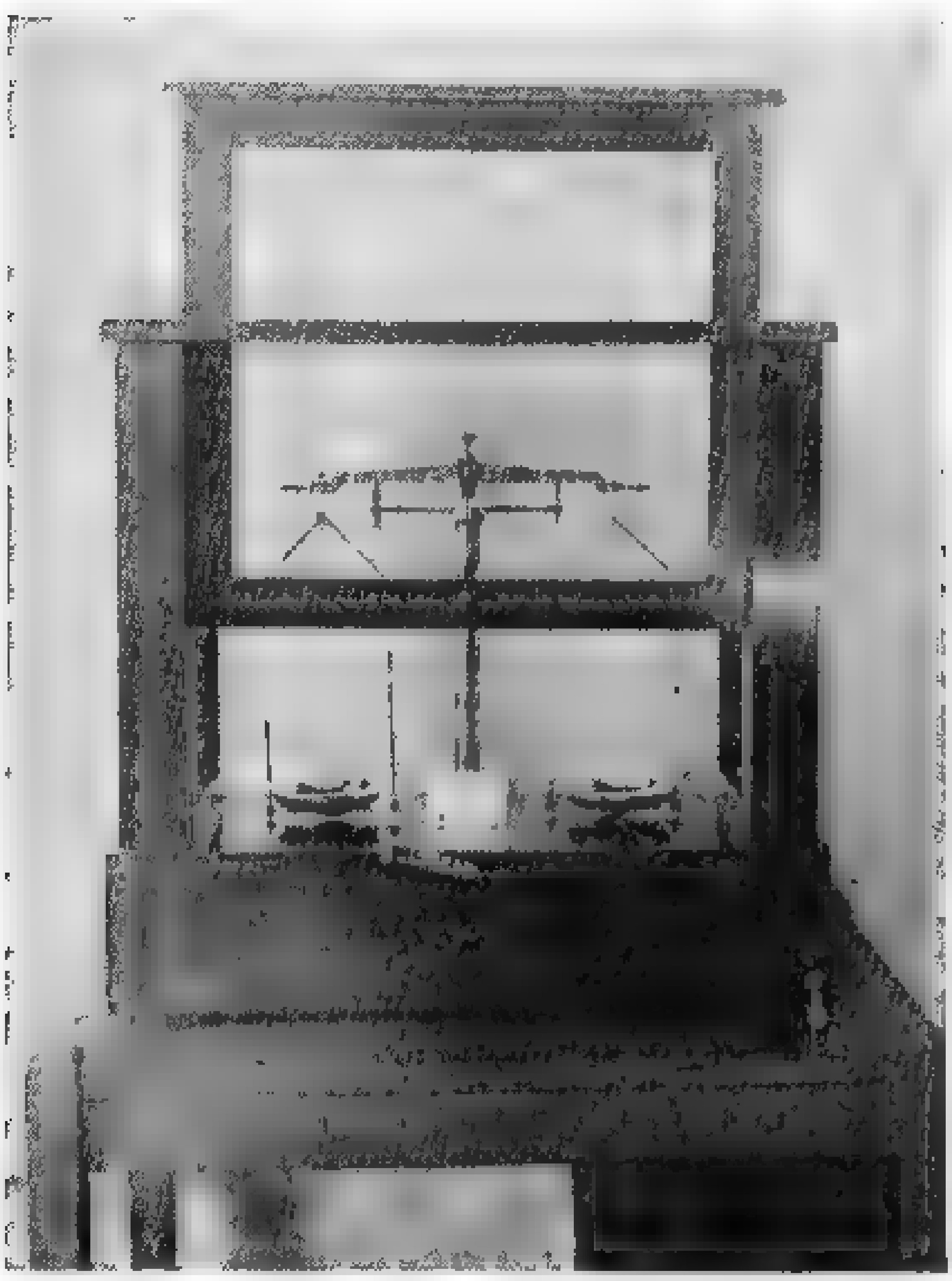
of stones and greatest of patience, can usually result in but one thing—total ruination of the knife, necessitating expensive replacement. I know—I experimented at a cost of more than $20.00 replacement charge!

In the lower-priced instruments, knives and bearings are invariably made of steel. In the more expensive grades, knives will be of steel and bearings of agate, or both knives and bearings made of the latter material. The steel in these knives is entirely different from ordinary steels. It is invariably of tremendous hardness, but at the same time more or less heat-treated to eliminate wear. In later years knives have been made of stainless steel, a steel containing a very high percentage of chromium, vanadium, nickel and other metals. Even on a very low-priced German instrument selling for less than five dollars I have noticed stainless steel knives and bearings.

When was stainless steel first used in this important point of balance construction?

To tell the truth, I don't know—and neither does anyone with whom I have had the privilege of

talking. Among the balances in my laboratory is an old Becker, manufactured by Becker & Sons, New York. (The firm name now is Christian Becker.) This instrument was manufactured nearly fifty years ago, and there is a record stamped on its cabinet indicating that it was returned to the factory for an overhaul in 1893. It has stainless steel knives. Whether these knives



An excellent low-priced cabinet balance made by Voland & Sons, New Rochelle, New York

were inserted in '93 or at the time of manufacture is not known. In 1934 I had these knives replaced with ones of the agate variety—which, incidentally, cost but a small amount more than stainless steel in the more expensive varieties of balances.

If a handloader can afford a balance installed in a glass cabinet, he will in the long run be more than repaid for the added expense. A balance costs money. It can be *ruined* in a few minutes. A good balance, however, if properly cared for, is good not only for a lifetime, but for several generations. Many better balances go back to the factory at periodic intervals every few years where they are completely overhauled, checked, and their accuracy restored if they have depreciated in the slightest. Invariably the report on the instrument indicates that it has lost little, if any, of its initial sensitivity, thus indicating that the overhauling job was absolutely "unnecessary" from a servicing standpoint—merely in the nature of a "check up."

A cabinet on an instrument not only eliminates the necessity for knocking it down and packing it away each time it is used, but it adds greatly to the appearance of the handloader's private laboratory or workshop. It keeps this delicate instrument free from dust, also eliminating side drafts in precision loadings, and this latter is of extreme importance wherever accuracy is desired.

No balance, regardless of its initial cost, should be overloaded in weighing. Since this is an instrument of precision, it must be treated with more than ordinary care. A careful workman would rebel at the thought of using a delicate set of micrometer calipers as a "C" clamp and thereby setting them tightly, springing them, and permanently ruining them. A reloader should also respect his powder balance. If his instrument has a capacity of one ounce, *it means very definitely that it should not carry more than one ounce* IN EITHER PAN!

The natural comeback to this statement will be that no reloader will throw powder charges approximating one ounce. True, yet your powder balance will prove of extreme value to you in weighing bullets for precision handloads. Most powder balances have a one-ounce capacity, although special instruments are made to weigh up to several pounds. These are primarily designed for weighing gold bullion, and instruments of this type cost several hundred dollars each—often as much as $1500.

Therefore, you can assume that from 1 to 1½ ounces is the maximum weight permissible on any powder balance. Since there are 437.5 grains to one ounce avoirdupois, it takes but two 220-grain Krag or Springfield bullets to top the ounce mark. Yet I have seen a great many loaders insert as many as a half-dozen of these bullets—over 3 oz.—in a pan to check the weight of loaded cartridges. This is neither proper nor wise. The overload is bound to strain the instrument, distort the beam a few thousandths of an inch, and dull or ruin the knives.

Using the Balance. There are certain fundamental factors controlling the use of any balance if precision results are to be obtained. If these fundamentals are not observed religiously, your particular pet load with 37.7 grains of powder will one day read 37.0, another day 38.5, and still another day 40.0. This statement may be disputed, but it can be readily verified by any reloader who cares to conduct a series of experiments.

Precision handloading means but one thing – uniformity of loading, producing uniformity of results. Without uniformity there can be no accuracy. Many careful handloaders can definitely trace the change in point of impact or change in zero of their pet loads to this *lack of uniformity in setting up the powder balance to weigh the charges.*

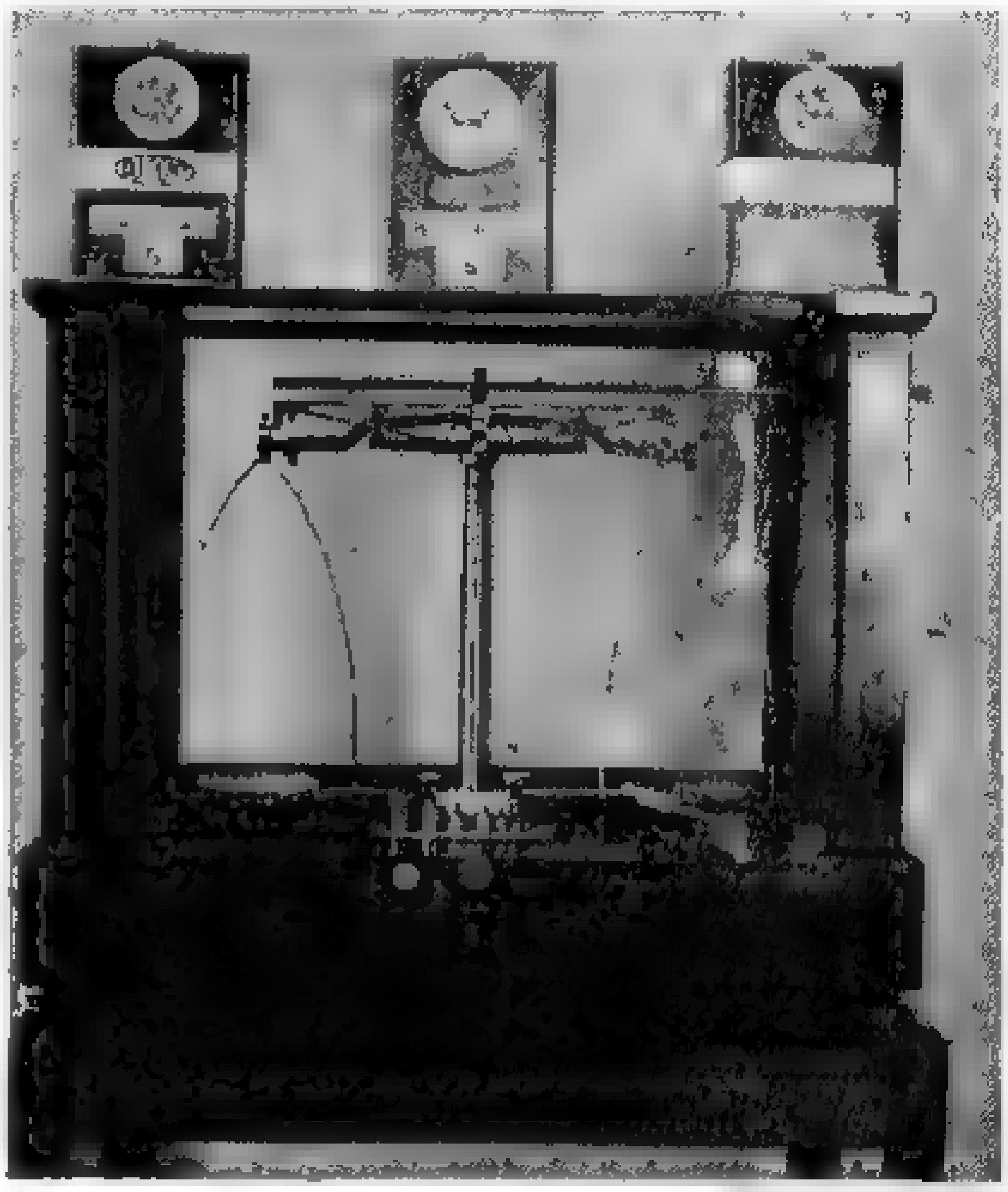
Worded differently, may we suggest that you look up any particular load using a certain combination of powders, primers, and bullets in the tabulated load section in this book. Notice the difference in velocity caused by a variation in powder charge of less than one grain weight. Visualize briefly the effect on group size of such low- and high-velocity loads mixed indiscriminately.

An entirely false reading can be obtained with any instrument which does not rest on a perfectly solid and level foundation. This is particularly true of low-priced balances which are not sensitive to the fine variations noticeable in the more expensive types. If a balance, for instance, known to be sensitive to .01 grain is not set perfectly level, particularly if it is tipped backward or forward, the operator having experience with that instrument will immediately notice a sluggishness in operation, indicating that there is some trouble with the set-up. Accordingly, he can readily locate the source of the trouble. On the low-priced instrument, however, this is likely to be overlooked.

Recently I tested an excellent little low-priced balance to check the error caused by setting it off level. The actual figures showed that in setting this instrument to throw a 10.0-grain charge with everything properly leveled, the average reading—as checked against my super-sensitive instrument having a known accuracy of .001 grain, and a master set of Voland weights meeting Class S, Bureau of Standards specifications—showed an average weight of 10.02 grains and an extreme variation of .04 grain. The instrument was then deliberately set in an off-level position, although not conspicuously so. It was zeroed in the latter position and an effort made again to throw 10-grain charges. The average in this case ran 10.44 grains, with a maximum variation of .16 grain.

This proper zeroing of the balance is of extreme importance in loading match-grade ammunition or any type of cartridge which develops in the vicinity of maximum pressures. While it is true that the guns of modern American manufacture now on the market will withstand pressures far in excess of the so-called "recommended maximums," it is extremely wise to take no chances, as maximum and over-maximum pressures can seriously damage a gun's mechanism without actually blowing it up. See the chapter on pressures for further detail.

Another thing which the reloader must take into consideration is the fact that if he has a balance "sensitive to 1/65 of a grain," it does not necessarily mean that the powder charges he meters out in using this instrument will be held that close. There is a very noticeable human error. This mechanical sensitivity means that when weights



Becker cabinet balance

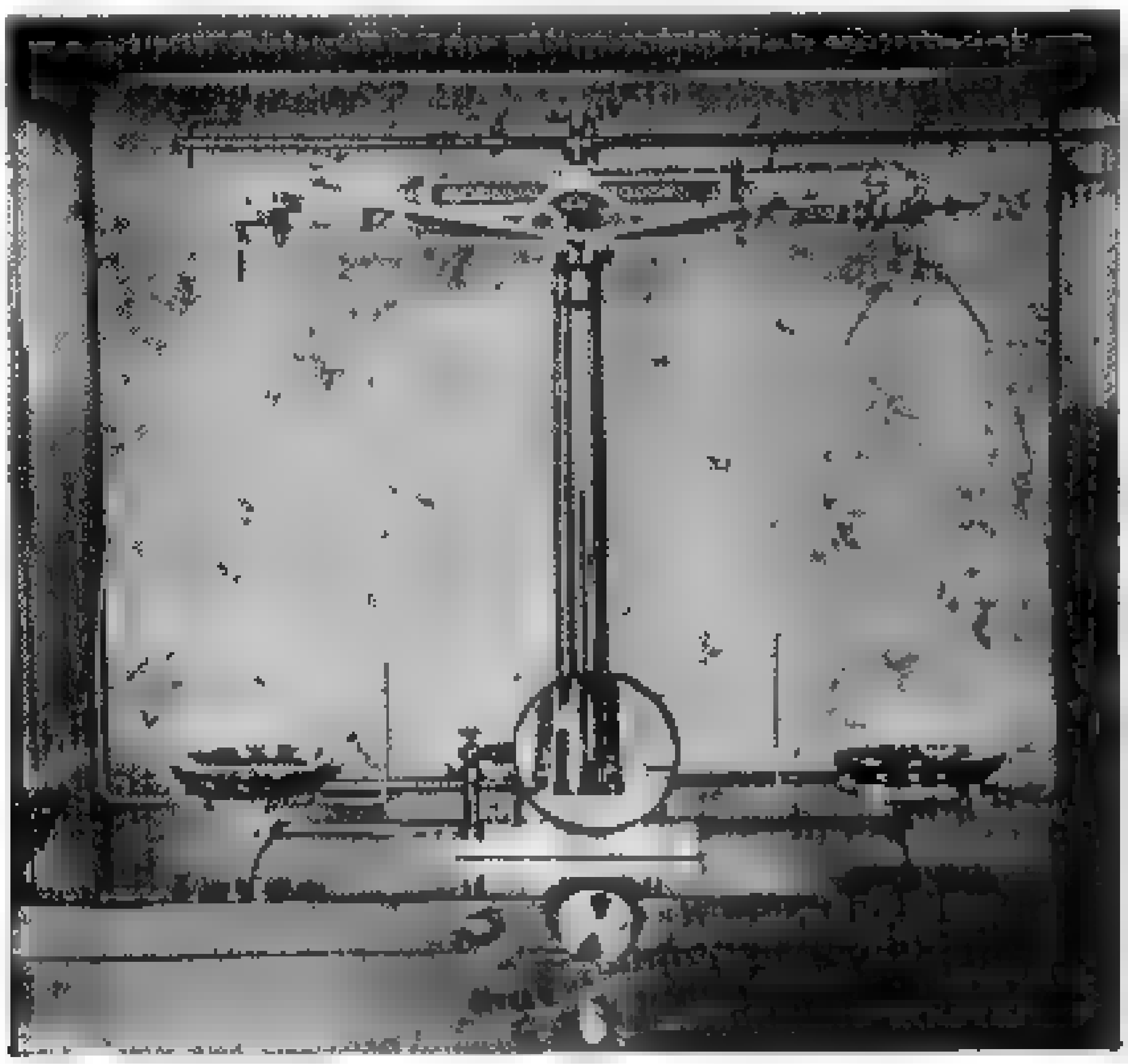
equivalent to 1/65 of a grain (one milligram) are added in one pan with the needle in perfect balance with the pans empty, that needle will show a very definite reaction. It may be only a sixteenth of an inch, but it *can be noticed.*

There are many things entering into this use of a balance which must be considered. No instrument can be used with superlative accuracy if there are drafts in the room occasioned by open windows. This is particularly true of a balance unprotected by a cabinet.

That a lengthy beam is necessary for the greatest accuracy is a fallacy that has long been in vogue. That it is not true can readily be determined by a careful study of the catalogs of balance manufacturers. A quarter of a century ago a balance for truly accurate weighing was believed to require a beam at least ten inches long. Today the best of these balances have had their beams shortened to approximately six inches. Why? *Simply because*

a short beam results in far quicker reaction to weight variations!

The most expensive instruments today are listed in the catalogs of their manufacturers with a very significant item in their specifications—"time of swing." Some instruments list this as 10 seconds, 8 seconds, 12 seconds, 15 seconds, or whatever the specifications call for. In commenting upon this



Close-up of Becker cabinet balance showing magnifier lens used to read the index scale

specification, Mr. Emil Voland, of Voland & Sons, Inc., makers of precision balances in New Rochelle, New York, states:

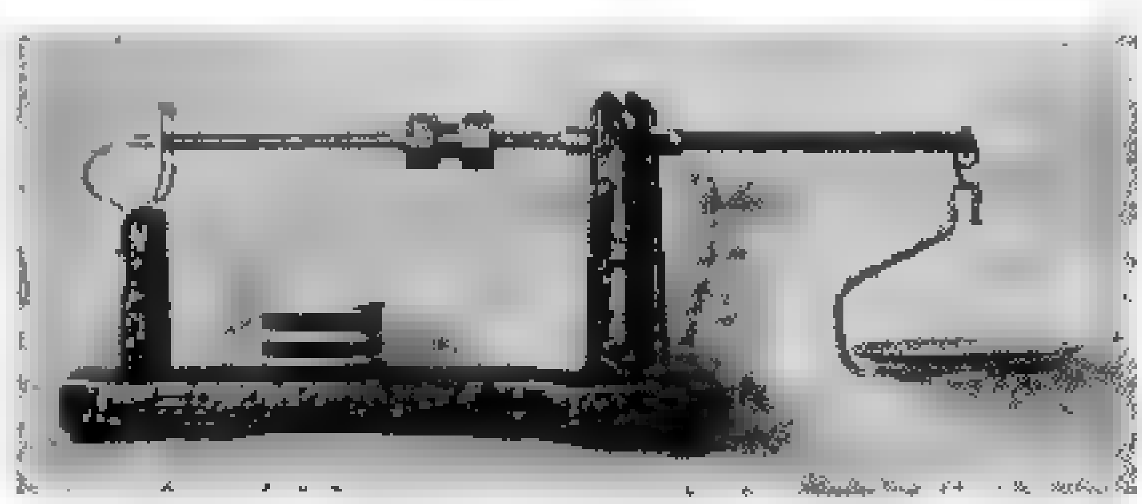
"The time of swing is from the center point to the end of the swing when pans are first released from the pan stops, and would be reasonably constant regardless of load in the pans. The number of oscillations to bring the pans to a complete stop cannot be determined until all weighing conditions are taken into consideration, such as drafts, vibrations on the table where the balance is resting, change of temperature, etc., all of which affect the number of oscillations of any balance."

In the more expensive balances used in various laboratories for precision speed work, various forms of damping devices designed to slow up these oscillations have been introduced, most of which have, of course, been patented by their designers. Since these usually are far too expensive for the average reloader, they will not be discussed here. One very practical type uses a small metal plate suspended from the top of the bow and operating between the poles of a small magnet.

How sensitive need a powder balance be for reloading purposes? Generally speaking, a reloader should hold his charges to the *maximum variation of $\frac{1}{10}$ grain.* In order to do that and still eliminate the human error, his balance should be sensitive to *at least* $\frac{1}{65}$ grain. True precision results can never be obtained unless a slow system of weighing is used with a sensitive balance; the needle or pointer should always come to zero to indicate perfect balance of the charge and the weights.

This human error cannot be too greatly stressed. If two professional target shots of equal ability were given two target rifles which look approximately the same, but which on actual test show tremendous differences in accuracy, the expert shot using the poor rifle will get better results than a "fair" shot using the same rifle, but will not equal the results of the other expert or even himself when using the super-accurate job. The same is true of a balance. If a balance is not sensitive to at least $\frac{1}{10}$ of a grain, it has little if any value whatever in the reloader's equipment.

After the instrument is properly set up and leveled by means of the various forms of leveling screws or legs on the balance support, it is ready for use. The necessary weights equivalent to the powder charge are then chosen and placed in the pan—after the instrument has been tested without weights to make certain that the pans balance. It is vitally important that the proper bearings be assembled on the correct side of the beam. Invariably, the left-side parts are marked with a single dot, file mark or prick-punch mark, while those on the right have two marks. On the end of the beams of the better grades of instruments one will



A fine little low-priced balance, the Pacific

find a small thumbscrew which may be used for zeroing. It is not unlikely that the operator will have to adjust this screw every time he assembles his balance. It is frequently necessary to make adjustments of this nature when the instrument has not even been in use for some time.

The predetermined weights are then placed in the pan. Most laboratories place the weights in the right-hand pan and the charge to be weighed

in the left pan. This system does not agree with the author's temperament and he invariably reverses it. Since he is right-handed, it is much easier to run powder into the right-hand pan than to work "cross-armed." A properly constructed powder balance, however, can be used with the weights in either pan, depending upon the operator's personal ideas.

A great many readers will question the author's reference to the "removal of the pans to pour the powder charge into the case." A thorough understanding of this terminology should be had. In the construction of the balance, we find that the beam-end bearings are usually separate units containing a form of double or "S" hook. From this hook are suspended the bows, and to the bottom of said bows is attached a flat or concave tray, often called a "pan." The *true* pan, however, is removable. It consists of a nickel- or chromium-plated brass dish, flat-bottomed, either with a pouring spout or plain. This pan invariably has an integral ear or "lip" intended to be used as a handle. Actually the lip serves a double purpose. If the balance owner ordered a pair of *matched* pans, he will notice a small patch of solder on the underside of this "handle." This is used to balance the units.

In setting up the instrument, first level and zero it without the weight of the removable pans on the fixed "bow pans." Then place the latter in their respective positions and check the instrument again. If it no longer registers "zero," correct by gently scraping a small bit of solder from the bottom of the heavy pan until they do balance. If they are "way off," build up the excessively light pan with solder beneath its handle. If you use this matched-pan system, be certain that they *do* match, as you cannot depend on memory to note which one is .3 grains less weight than the other, for which you must make allowance in setting up the instrument.

Some pans are aluminum, and as such do not have solder on the handle for balancing. A fine file, removing a small bit of the edge of the lip or handle, does the job, but aluminum pans are rarely found in matched sets. Bakelite, celluloid, glass and porcelain are all available for balance-pan material. The writer used a 2½-inch crown-glass ornamental clock crystal at one time with excellent success, but the lack of high side walls caused a certain amount of powder spillage in weighing.

It is not necessary to purchase matched pans. Two identical pans look excellent in operation, but cost twice as much as a single unit. A single pan can be obtained from any maker of balances and a suitable counterweight made by the operator to balance the pan. On one balance owned by the writer, he used a set of weights to determine the amount necessary to bring the balance to zero and found it ran 176 grains. From the bow bearing was suspended the common double hook, the bow hanging from the upper hook, leaving an empty notch below it. A 180-grain .30/06 Palma match bullet was bored out at the base to form a conical cavity, and a small screw eye inserted. By dint of many removals of the screw eye and a bit of work

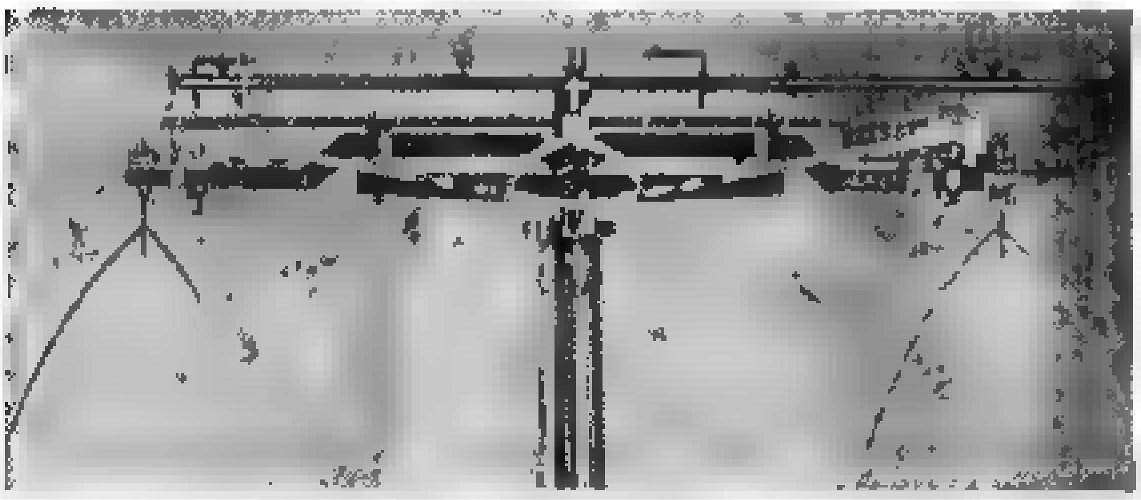
The author's set of master weights, made by Voland & Sons to Class S Bureau of Standards specifications

on the core with the point of a sharp knife, the bullet with its screw eye in the base was made to balance the pan. It was then wiped free of fingerprints and suspended on the spare hook at the top of the bow. The effect was pleasant to the eye, and the counterbalance was out of the way, leaving the bow pan clear for the weights desired to balance the required powder charge in the charge pan.

Not long ago we found a reloader friend doing a fine piece of work without the use of pans. He merely employed one of those small cardboard boxes in which ammunition manufacturers pack 25 metal-jacketed bullets. He found that the cover nearly balanced the bottom, and brought them into balance through skilful application of a sharp pair of scissors. A bit of experimenting with gummed paper, stuck on the bottom of the lighter one, would also have done the trick. In the latter case, the patch of gummed paper should first be

cut oversize and weighed with the lighter unit, the operator gradually cutting it until of the proper weight. It should then be wet and stuck on, and the unit set aside to dry. This system of using cardboard boxes is not recommended, however, because of the hygroscopic qualities of the cardboard; it absorbs moisture from the atmosphere and fingers through handling.

The fastest weighing is done with one of the better-grade instruments equipped with "pan arrests." These are two small arms—adjustable, of course—which have felt tops to contact the underside of the pans and hold them so that the pointer registers at zero on the index. The oscillations caused by the insertion of powder to balance the



A graduated beam with riders (movable weights) is excellent for weighing fractions of a grain

weights are checked by these pan arrests and recommence when the arrests are depressed by a convenient thumb button on the front of the cabinet or balance base.

Most quality powder balances have some form of beam support to take the weight of the beam, bow and pans from the knives when the instrument is not in use. This is controlled by various forms of releasing mechanism, of which there are two major types: one, a "lift," and the other, working in the opposite direction, known as a "fall away." In the "lift" type, the center beam bearing is controlled by a rotating thumb nut on the front of the base-support or cabinet to lift the beam and suspended bows and pans from special holders, thus bringing the knives into proper contact with their bearings.

In the "fall-away" type the beam supports are lowered by a similar thumbscrew arrangement which at the same time lowers the beam so that its center knife rests on the center bearing. In continuing it lowers the bows until the beam knives on either end touch the bow bearings. The fall-away is usually more expensive but the results in operation are essentially the same.

It is of extreme importance that a full powder charge or group of weights be not placed in the pan while the instrument is suspended with the knives contacting the bearings. This can cause serious damage to the knives. Accordingly, the experienced operator partially fills his pan *before* placing the knives in contact with their bearings This is also much speedier than the other way.

There are numerous ways of using the balance to simplify the work for the operator. One of these is the use of a powder measure set to throw a charge slightly under that required. For instance, when the author loads a 48-grain charge in the .30/06 he sets a powder measure to throw about 46 grains. This charge is emptied directly into the pan according to the type of measure used at the moment and its ease of operation.

Caution! Do not mount your powder measure on the same bench on which your balance is installed. The hammering or vibration is likely to injure the balance knives

The Belding & Mull measure is extremely useful for this type of work, although we frequently use one of the several other types available. In the B. & M. the charge chamber is a separate unit. The charge is thrown and then poured by hand from this charge chamber or glorified measuring cup directly into the pan. In the latter case we found that very frequently, particularly with large-grain powders such as IMR #15½, #17½, #3031 and Hi-Vel, there was a tendency for a great many grains to bounce out of the pans, despite the fact that we use special high-rimmed types. This was overcome very simply. A small piece of ordinary bond letter-paper was rounded to form a section of tube approximately one inch high and two inches in diameter.

With the balance weight off the knives, this tube was dropped into the pan and the charge from the powder measure emptied directly into it. The tube was then lifted aside to await the next charge. Addition of the two or three grains weight necessary to bring the charge into proper balance is another matter of considerable importance if reasonable speed is to be obtained Oddly enough, there is no set rule for this. The operator should experiment briefly, and once he determines a system which appeals to him, he should use it to the elimination of all others, thus developing skill.

Methods. In visiting various laboratories, including the private labs of a great many reloading friends, we have watched with interest the methods employed, and while some systems proved extremely speedy for a particular operator, they were worse than useless to others.

Some chaps, for instance, use a small spoon less

than a quarter of an inch in diameter on the bowl. Such a spoon can be readily made out of a piece of sheet aluminum, its bowl formed by a brief hammering with some round-headed blunt instrument with the aluminum held over end-grain softwood. In operation a small dish of the powder being used is kept on the front of the balance where it can be reached without undue effort on the part of the operator. He dips his spoon in and puts the necessary grains into the pan. I have seen some of the boys in Burnside Laboratory handle this spoon system so as to drop a single grain of #17½. I can't use it.

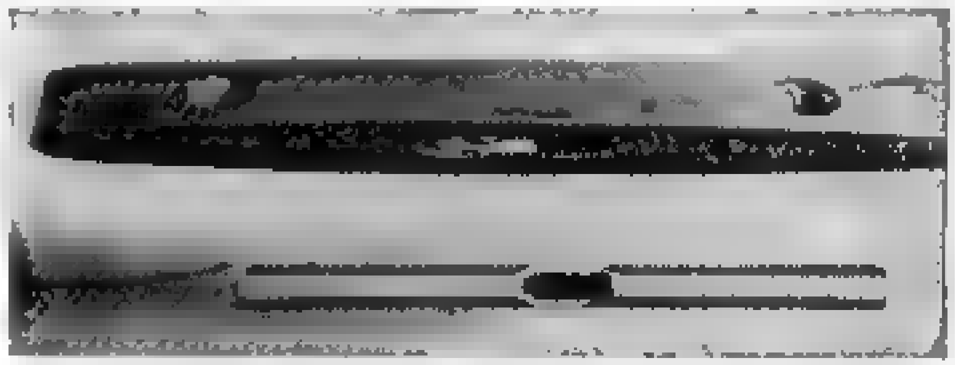
On the other hand, some chaps use a charge cup similar in form to the old-style charge cups still available from the Ideal Manufacturing Company. This was essentially a round cup formed of brass with a short handle soldered to one side. The bulk of the charge is poured from this cup directly into the balance pan and the necessary amount added to bring it to balance. The same pan-checking system is used—with excellent results in the hands of a skilled operator.

I use my own system and in the weighing out of a great many thousands of charges of all weights and powders, and have acquired a reasonable amount of skill. I use an ordinary new .38 Special or .44 Special empty cartridge case which is stored in the balance cabinet at all times where it is available for use without extensive "research." In use, these shells are dipped into the reserve supply of powder usually kept in a small cardboard box in the front of the cabinet, and I pour from the shell by a simple process of slight rotation between the thumb and forefinger of the right hand. Even with my supersensitive balance—which is far too "finicky" for normal reloading use—I very rarely drop too much powder into the pans, necessitating removal of a portion of it and beginning over again.

The pouring shell used should be a new one, as the clean, bright interior gives far better control over the flowing qualities of a fine-grain powder. A used shell can be employed but is not so sensitive to the motion of the finger tips. It is possible with reasonable skill to drop but two or three kernels of the finest-grained smokeless powder such as Du Pont #1204 or Hercules #2400. With any of the medium-grain powders, such as Du Pont #18, it is a simple matter to drop a single kernel at a time—all of which is far less than is required for reloading purposes.

It is very common for the reloader to get *too much* powder into his pan, thus necessitating the removal of a portion of it. When this happens, it is vitally important that most careful attention be paid, and that no effort be made to remove any powder *without taking the load off the bearings and knives!* In a "lift" or "fall-away" type of balance, this is very simple, as a partial twist of the thumb nut does the job. This load must also be taken off the bearings before the pan is removed to discharge the powder into the awaiting cartridge cases.

I have several friends, however, who have an uncanny skill in removing this surplus powder with a scoop or spoon system. I have watched with keen admiration the speed with which they pick up one or two kernels of smokeless powder.



Two inexpensive levels of practical value to any handloader. Torpedo type is about 8 inches long. The pencil type is made of a hexagon aluminum tube, and measures 6 inches. Both of these are available at any hardware store for a few cents

Usually a man capable of delicate pouring from a spoon or scoop can at the same time handle it with sufficient smoothness to remove powder. However, I resort to my same .38 Special or .44 Special shell, using the larger shell for the coarser-grained powder. The weight is taken from the bearings and the open mouth of the shell scoops with a slight circular motion a small quantity of the powder from the weighed charges.

An extremely useful accessory to the reloader is a magnifying glass mounted over the index to enlarge the view of the index scale and the swinging needle. This relieves the eye strain to quite a degree when using the balance for an extended time. This magnifier, as made by Voland, consists of a 2½-inch lens with a very narrow rim mounted on an excellent aluminum pedestal and adjustable by means of a swinging arm for both height and angle. It sells for $5, and while it is an attractive accessory, it is not necessary for a reloader to invest so much in a unit especially designed for this purpose. Any small magnifying lens available in the "5 and 10 cent" stores can be used. A 2-inch or even 1½-inch pocket "reading glass" can be mounted by the ingenious reloader to serve the purpose fully as well as the most expensive magnifier with achromatic lenses. Distortion does not matter if the glass is centered over the zero point. The distance will be equal on both sides and will

serve to show at a glance how near to actual balance the charge is at any given moment. After all, it is only the center of the glass, or zero point, which is actually used.

Balances usually within reach of the average reloader's pocketbook do not have a graduated beam designed for the use of "riders," but it is often possible to pick up a used instrument of this type at

Weighing powder calls for concentration on the work at hand. This job should always be done sitting down to relieve as much strain as possible. For flowing powder from your scoop into your balance pans, it is advisable to rest the elbow on a table. An empty cartridge box before you should be about half filled with the powder being used, and you should always draw from this rather than from the canister. Take this job seriously

an attractive figure, and the use of the riders will be briefly described here.

Assume that your beam has a top surface or plane numbered with 100 graduations from the center point to each end. Usually these are numbered from one to ten, with each space subdivided into from four to ten minor graduations. If the latter, you will find the beam has 100 lines on each side of the center. No. 10 (or 100 as you choose to look at it) will be exactly over the bearing from which the bow or pan support is suspended.

A "rider" is a small unit built of wire in various sizes and weights, and designed to straddle the beam. The center portion of the top is invariably twisted to form a loop which the hook on the rider rod engages (on a cabinet-type instrument) that it may be lifted off the beam or moved from point to point without touching with the fingers. On non-cabinet or "exposed" balances, the rider is moved with tweezers.

If a rider weighs 1.0 grain it will balance a one-grain charge in the opposite pan when it is moved out on the far beam to the No. 10 mark, located exactly over the knife bearing. If it is placed over the graduation marked "6" a charge of .6 grain will be required in the opposite pan to bring the needle into balance. If it is moved to three graduations beyond the "7" mark (assuming the space between the numbers to be subdivided into ten graduations) a weight of .73 grain will be required to balance. If a rider weighing .1 grain is used, each graduation, of course, will represent one-tenth of the figure described above.

A rider weighing one grain used on a balance having a beam graduated into ten parts will eliminate the necessity for the use of fractional grain weights. It is also of extreme value in checking the weight variations in bullets. If, for instance, the reloader desires to check a group of 150-grain bullets and believes his weight will vary from 149.5 to 150.5, he merely places weights totaling 149.5 in one pan, then uses the riders to balance the bullet. The weight of the rider is determined, of course, by its position on the beam, added to the weights in the pan—in other words, with 149.5 grains total in the left-hand pan, a 150-grain bullet in the right pan and the one-grain rider placed on No. 3 graduation to balance. The weight of the so-called "150-grain bullet" is thus readily determined as 149.8 grains.

There is another type of balance, widely used by reloaders, which is worthy of discussion here—the Fairbanks Miners' Assay type. This form is exemplified in several widely used balances of low and medium price, manufactured by Fairbanks. Pacific, Troemner, Torsion, Brown & Sharpe, and many others. This miners' assay type is sold and recommended by Ideal, Bond, Belding & Mull and other makers of reloading equipment. It has earned its success primarily by its sturdy construction and low price. It is a refined version of the old-fashioned "grocery store" type of scale, in which no springs are used. Instead, small washers, serving as weights, are suspended on an arm to get the desired weight, usually in tens of grains. Individual grains, running from zero to ten grains by quarter-grains or tenths (depending on the grade of the instrument) are measured by means of a unit movable on the graduated beam. In this type a single pan is used which ordinarily takes the form of a "scoop" suspended at one end of the beam in a cradle formed of a non-flexible wire Powder is poured in to bring the beam into balance, whereupon the scoop is removed and the powder run into the waiting cartridge case.

For the checking of bullet-weight variations, this type of construction has never been beaten for speed and ease of manipulation. One merely drops a bullet into the pan or scoop, slides the weight along the beam to balance, much as he would a "rider," and quickly notes whether or not it falls within the variations he has set as "working limits." One reloader known to the author uses a scale of this type to check all his cast bullets after lubrication. He often finds variations of as much as two grains, and before starting the job he places a series of empty boxes beside him marked "157," "157.5," "158," "158.5," and "159." Bullets weighing more or less are relegated to the scrap metal, others inserted in their proper box. Thus when he loads his .38 Special for accuracy, he eliminates the possibility of "stringing his shots" due to variation of bullet weight. Fast? I've watched him grade more than 300 bullets in an hour—something like six times what I can do with a cabinet balance!

A variation of this form is the Pacific, manufactured by the Pacific Gun Sight Company. This unit is suitable only for weighing powder charges, since it is of a "fixed" type of construction. The predetermined group of weights is inserted in the pan, and the two large brass thumb nuts, operating on the threaded beam, are turned toward the end or the center to balance the weights. When this has been accomplished, the nuts are locked in position by tightening them together with the fingers, thus "setting" the balance to the equivalent of the weights in the pan. These weights are then discarded and the powder run into the scoop to bring the beam to the balance point. As long as the nuts do not shift their position—and properly tightened they won't—the charge will remain constant, even after the instrument is disassembled and put away. It should, however, be checked the next time it is used, even if it is desired to throw the same weight of charge.

Cost. How much must one pay for good powder balances, and where can they be obtained? In addition to the loading tool makers previously mentioned, numerous old established manufacturers have excellent numbers to offer handloaders.

Henry Troemner, one of our oldest balance firms, established in 1840, is now located at 911 Arch Street, Philadelphia, and manufactures an extensive line of instruments in numerous grades. He publishes a special catalog which can be obtained for the asking. This catalog places several instruments within reach of the average reloader, but because of fluctuating prices it would be better to secure quotations direct.

Christian Becker, of 92 Reade Street, New York City, another old firm (established in 1836), manufactures an excellent line of balances and weights. These instruments, however, are somewhat more expensive than the average reloader would care to use. This firm also operates The Torsion Balance Company of the same address, which manufactures various instruments. Literature on these is available from the manufacturers.

Wm. Ainsworth & Sons, Inc., 2151 Lawrence Street, Denver, Colorado, is another old established firm which has for many years manufactured the expensive and highly satisfactory balances and weights frequently found in our best laboratories. While many models are suitable for the reloader, the prices are considerably greater than he would care to pay. Catalogs and special circulars on sets of weights are available to all who request them.

Voland & Sons, Inc., of New Rochelle, New York, also manufacture a line embracing the medium and higher brackets, many of their models running up to $1000. They have, however, a truly practical instrument known as a "Pulp Balance," their number 1053, and priced as low as $22. I have tested one of these instruments and found it to be sensitive to 1/08 of a grain. It has agate bearings, steel knives, brass parts highly polished and lacquered, and is, of course, equipped with a level and screw legs for leveling the instrument. It has nickel-plated pans 2¾ inches in diameter, and on the lowest-priced model has a capacity of 2 oz. (875 grains) in either pan. It is mounted on a mahogany box containing a drawer which will hold the entire instrument when taken down.

Voland also makes this same model, known as 1053-A, with an excellent French mahogany cabinet, glassed on all sides, and a counterpoised door. The charge is but $12 additional for the cabinet, and this, to the writer's knowledge, makes it the lowest-priced cabinet balance on the market. It is sturdily constructed, very sensitive, and easy to operate.

If a reloader desires a high-grade instrument and is willing to spend a reasonable sum for it, he can often secure from many of the better-grade balance manufacturers a quality instrument either of their own or of another make which has been "traded in" on a new model. These used balances are invariably overhauled and placed in excellent condition so far as sensitivity is concerned. The Voland people, incidentally, tell me that they frequently have a few of these instruments which are sold at extremely low figures.

Among the low-priced outfits, the most practical I have seen in recent years is a handmade affair

constructed by Mark L. Hershey, 89 West Street, North, Hillsdale, Michigan. Mr. Hershey sells these for $3.50 complete, and I find that with reasonable care a skilful operator can throw charges accurate to within 1/50 of a grain. On occasion, however, it will show variations as great as .09 grain. Extended testing shows that it runs well under the tenth-grain standard in maximum variation.

This instrument comes packed flat in a well-made little sliding-cover wood box. It is set with a beam support in socket and has a means of ad-

The practical little Hersey powder balance

justment on the beam for perfect balancing or zeroing of the instrument. It comes equipped with a small set of handmade weights which run as close to accurate as any of the standard makes of low-priced weights now on the market. Don't expect a de luxe instrument in this low-priced affair. Mr. Hershey tells me that it was designed chiefly as a check on powder measures, but it is suitable for the reloader who does not care to spend much money on a balance.

Various other types upon which description is readily available in the catalogs of such loading tool makers as Ideal, Bond, Belding & Mull, will not be described in these pages.

Weights and Accessories. No balance, regardless of its sensitivity, can possibly throw charges more "accurate" than that of the weights used by the operator. Yet very little attention is paid to this weight problem. A good set of weights is fully as delicate as a good balance. In fact, it is *more* delicate and must be handled with the greatest of care. The weights should not be handled with the fingers, as the slightest moisture on them can create a form of corrosion not visible to the naked eye which will totally ruin accuracy.

A good way to take care of your weights is to store them in a dust-free box where temperatures are reasonably constant and free from excessive humidity or moisture. Some handloaders use their weights at rare intervals, preferring to make up special weights of brass, aluminum, or some similar material for the actual process of weighing. These are often built up at home in the exact amount of the most common charges used by the handloader—in other words, to fit his pet rifle or handgun load. The idea is entirely practical, but it is well to check your homemade weights at regular intervals against your "laboratory" set of master weights to be positive that oxidation or scratching has not altered them appreciably. Homemade weights are rarely treated with the same reverence by their owner as his set of "tailor-made" ones, although unquestionably they have a very definite niche in the handloading game. In my own work I very often use them—but I also use my expensive set of master weights for actual loading, particularly loads for super-accuracy.

In this respect I take the attitude that nothing yet manufactured is too good for use. I have owned and handled custom-built rifles and shotguns, arms which cost from $200 up. I have never handled a gun I wouldn't use in the field, regardless of its fancy stock and fine finish—and I rarely bring it back looking like a war relic, either. Delicate weights, like a de luxe gun, can be freely used without damage—*if used right!*

Weights up to ten grains are usually made of aluminum in the lower-priced sets and in various nickel or chromium alloys, such as "palladium gold" or whatever the private trade name used by the manufacturers may be. In the more expensive sets they are made of platinum. The larger weights are made of either brass, bronze, or solid nickel, and are protected from oxidation or tarnishing by gold plating, chromium plating, or a coat of clear lacquer.

The most accurate weights ever turned out can be quickly ruined through exposure to assorted atmospheric conditions. They should be kept in some form of box or cabinet, protected from contact with each other and free from dust and dirt. The experienced operator never handles his weights with bare hands. Small fractional weights are manufactured either flat or slightly "dished." The flat types invariably have one edge bent at right angles so that they may be readily grasped with tweezers. The rim on the dished types also serves this same purpose.

A good set of professional weights invariably comes equipped with a small pair of ivory tweezers —usually made of flat spring brass with ivory tips attached by small screws. The ivory will not scratch or otherwise mutilate the delicate weights and is easy to keep free from any corrosion-producing liquids. *These tweezers should never be used for any other purpose.* A set or "pair" of these tweezers usually sells for about \$1.25, while the ordinary plain brass tweezers are only about 25 cents. Your neighborhood drug store can supply something nearly as good for this purpose in the form of a pair of small eyebrow tweezers such as are sold to the ladies for their periodic hair-pulling episodes. These tweezers sell for various prices running from ten cents to half a dollar.

Weights are available from all the better-known makers of balances. They are manufactured in both the metric and grain types. Many foreign countries use the metric system, listing weights in *grams, milligrams,* and *centigrams,* at the same time listing measurements in the metric system of *meters, centimeters* and *millimeters.* Conversion tables will be found in the appendix of this volume, but throughout this book the American system of avoirdupois grain weights has been used.

This, incidentally, brings up an often-asked question—"Just why do they refer to the sensitivity of a balance as 1/65 grain? Why, instead, don't they refer to 1/100 or 1/50 grain?" As a matter of fact, most balances are manufactured today, even in this country, for use with metric weights. Any balance, of course, designed for metric weights can readily be used with weights of the grain system with equal accuracy of result. A *gram* is the equivalent of 15.4 grains. A milligram, therefore, is 1/1000 or .001 *gram*. One milligram, therefore, equals .0154 grain or, to express it in the terms of a common fraction, 1/65 of a grain. Since the metric system is more universally used, even in the United States (except among reloaders and ammunition manufacturers) an instrument having a rated sensitivity of one milligram is translated to read 1/65 grain.

The serious reloader who wants a truly accurate group of weights and has a balance capable of utilizing their accuracy can manufacture them for himself by securing a single weight of known accuracy. These weights are manufactured by makers under various Bureau of Standards specifications and can be purchased either singly or in sets. They are also manufactured in what is classed as a "single-check" or "double-check" grade. The double-check invariably costs at least 50% more than the single-check and includes much handwork in rechecking and turning them out to specified accuracy tolerances.

Bureau of Standards tolerances on 7.0 grains in Classes A and B permit a variation of only .004 grain. In Class C, a variation of .02 grain is permitted. Similarly on a 10-grain weight, the specifications permit of a variation of .004 in Class A and B, and .02 in Class C. Various other classifications of the Bureau of Standards have correspondingly different accuracy tolerances. It is not generally known, but it is possible to have any good set of weights inspected and reported upon by the Bureau of Standards for a reasonable charge. At the same time, these specifications may be obtained by an interested party by writing the Bureau of Standards of the Department in Washington.

According to our official specifications, weights are divided into three classes: namely, "M," "S," and "S2." The chief characteristics of these classes are, briefly: specifications for Class "M" weights require that they be strictly of one piece and otherwise suitable for the most reliable reference standards for weighings of extreme precision. Weights of both Classes "S" and "S2" may be of the familiar "screw knob" type. Those of Class "S" must show a reasonable degree of stability when weighed under different conditions of atmospheric humidity. For weights of Class "S2" the tolerances (i.e., the maximum allowable errors) are five times those of Class "S."

"In both the high precision test and the moderate precision test under Class 'M' and in the determination of correction test under Class 'S' the Bureau certifies a correction for each weight; in the tolerance test under Class 'S' and in testing weights of Class 'S2' the Bureau certifies that the errors of the sets will not be greater than the specified tolerances," according to an official explanation of Department specifications.

The schedule of prices for the servicing of weights by the Bureau of Standards was made effective August 1, 1932, and is in operation at the present time (1947) without change. We find that Class "M" standard weights that are not new or not plated are serviced for each set or single weight or group that is submitted, tested and certified and reported on as a unit for the regular inspection, cleaning, handling, etc., but not including tests for accuracy, \$1. The "moderate precision" test of each weight, including testing accuracy and certifying or reporting the correction for each weight against the Department's standards, is \$.75. The "high precision" test is \$1. The minimum total charge billed for any one test or group of tests is \$2. Class "S" laboratory weights that are

one-piece or screw-knob weights not plated or lacquered, or weights that do not need to be given a test for the effect or changes in atmospheric humidity, are serviced for $1 for each set of single-weight or groups. Special work is charged according to its nature.

The accuracy of the Bureau's requirements for metric weights can readily be appreciated when it is pointed out that a 1-gram weight (15.4 grains) must not vary more than .1 mg. (1/650 grain) in either Class "M" or Class "S" specifications, and not over .5 mg. (1/130 grain) in Class "S2."

Catalogs and technical books on the subject of balances and weights are woefully lacking in any information upon tolerances, merely listing a group of weights as Class "S," Class "M," Class "C," etc., leaving it entirely to the purchaser's imagination to determine the permissible tolerances in this field. Even the Department of Commerce fails actually to "publish" any literature on these specifications, although it does have a few mimeographed sheets available on request. The writer knows of no book on this subject which would be helpful to a reloader who seriously cares to investigate the subject in greater detail.

It is well to know, however, that if you desire to acquire a good set of weights, you can have them tested and adjusted by the Bureau of Standards, which is by no means a commercial enterprise, thus eliminating the necessity of returning them to the manufacturer with the ever-present suspicion that he might be inclined to give you a prejudiced report in an effort to stimulate the sale of new equipment.

Just what relation need the handloader's weights have to the accuracy specifications of the Bureau of Standards? Merely this: If you desire to duplicate a load upon which the various powder laboratories have given definite specifications concerning powder charge, velocity and pressure, your weights should *closely approximate* those used by the powder laboratory. Hence a set of accurate weights will enable you to reproduce very definite results. There is still another angle to this picture. The handloader who desires to play with super-power loads—which the writer does not generally recommend—should be extremely careful in his handling. If, for instance, he uses a crude set of weights which happen to be a combination with a supposed total weight of about 50 grains but are as much as 1.5 grains under weight (and this is by no means uncommon; I have checked many sets of weights for handloading friends and have found this variation), he is quite likely to get into extreme difficulties with loads developing dangerous pressures. On a 50-grain charge, for instance, in the .30/06 cartridge, which gives the maximum recommended breech pressure of 55,000 pounds, a half grain by weight may run it up to 60,000 pounds, and one and one-half grains might even exceed 75,000 pounds, depending entirely upon the type of bullet used and other problems of interior ballistics.

One should bear this in mind and go very carefully into the handloading of so-called "maximum" charges. The mere fact that you have a set of weights, one of which bears the imprint "50 grains," does not necessarily mean that that weight is actually 50 grains—or that it ever was, particularly if it is in the low-priced class. There is one satisfaction, however—most weights decrease in weight with time rather than increase, although the latter is quite possible. This means underloads rather than overloads.

Balance and weight manufacturers, in constructing low-priced weights, also favor an *underweight* rather than an *overweight*. Therefore, if you load a 50-grain charge and get positive results and enter in your notebook proper sight settings, etc., for this particular load, you should always strive to turn out a perfect duplicate when you next assemble the same load. If one is done with accurate weights, and those duplicating it are done with inaccurate weights, there may be a noticeable variation in point of impact on the target, although the latter load may be fully the equal of the former from a standpoint of group size.

The weight sets may be summed up briefly. If you use a set of factory-built weights, regardless of its initial cost, and handle the weights throughout their useful life with proper care, they may lack the superlative accuracy of Bureau of Standards Masters, but they will be entirely satisfactory for your loadings.

It is wise, however, to use the *same group of weights* for each duplication of a given load. Assume, for instance, that you have an assortment of small weights. If you previously used your two 20-grain weights, a 5 and a 2 to get a 47-grain load, in duplicating it use the same group, not three 10's, two 5's, three 2's and a 1. The different combination may actually read 1/10 to 2/10 grain higher or lower.

XXI

POWDER MEASURES AND THEIR USE

FIFTY years ago the "powder measure" was some sort of scoop or charge cup which, when filled with black powder, gave a normal "charge" for a particular weapon. Old-timers soon learned just how to handle these charge cups, how to run the powder in to prevent much variation, how to level without packing, and how to handle for reasonable speed; *but* that was the black-powder era. . . . The measuring of modern smokeless powders is an entirely different proposition, and disaster awaits the careless operator who believes that "a full charge of powder is all you can possibly get into a shell."

Modern smokeless powders act differently in various types of cases. Some refuse to burn properly in straight cases or at low pressures. Others will not burn consistently at high pressures. Some smokeless powders can be compressed without affecting their performance. Others absolutely refuse to be compressed and are inclined to make their displeasure known by taking apart your pet gun.

In the days of the old muzzle-loader, the powder horn frequently had a little gadget attached to enable the loader to meter out the proper quantity of black powder for his old coal-burner. Powder horns passed out of the picture with the coming of the metallic cartridge case, and at this time the "charge cup" was born. . . . It has lived a long and successful life and even today has certain definite uses in the realm of handloading. Many of these charge cups can be used reasonably well for true bulk or the later concentrated bulk types of powder such as Gallery #75 and Sporting Rifle #80. Some of these charge cups were adjustable but the majority were of the fixed variety.

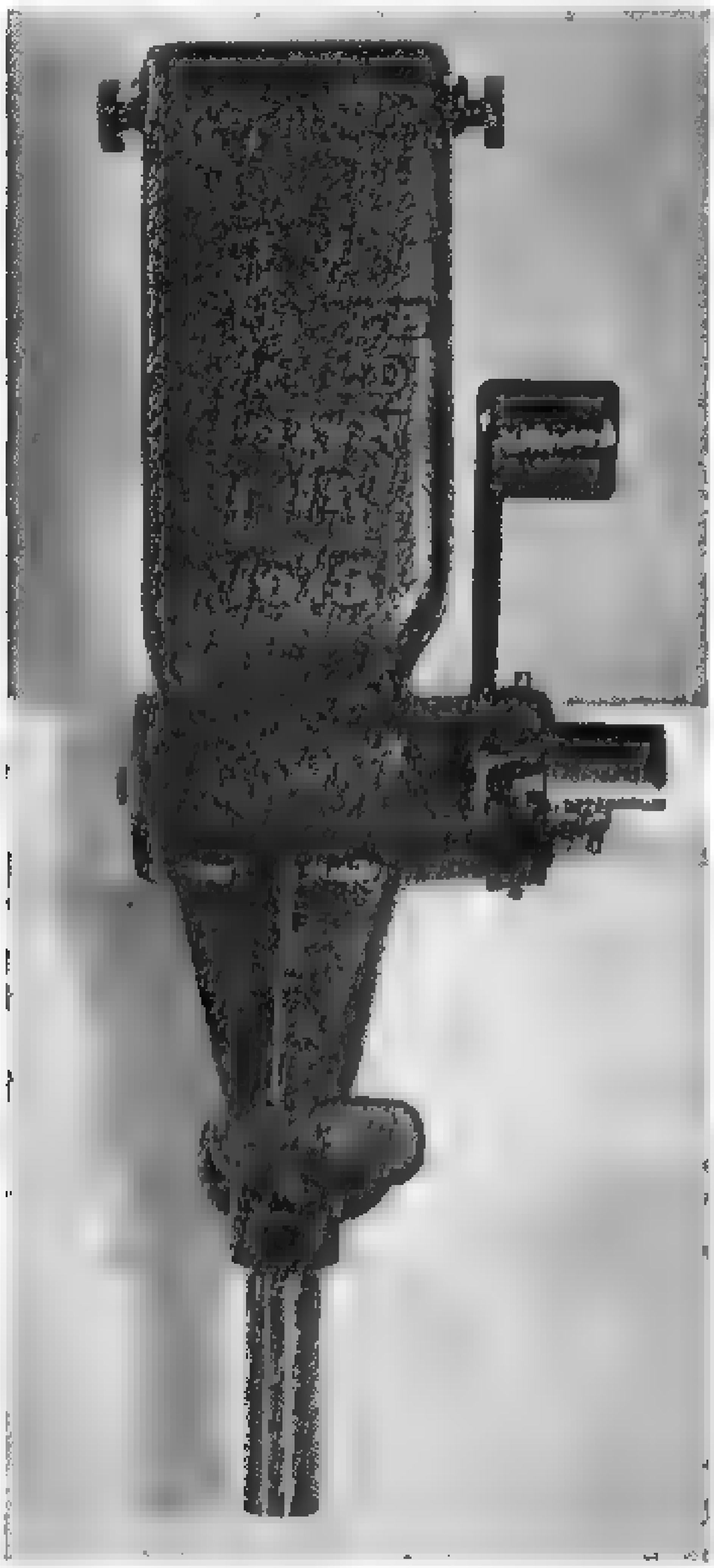
Homemade Charge Cups. Cups of this type can be made at home by using empty cartridge cases. New revolver cases are by far the most satisfactory. To make one, take a clean new shell, decap it and block the flash hole with solder. The solid-head variety of case is much better than the type having the semi-balloon pocket protruding into the case. The easiest way to make a charge cup of this sort is to weigh out two or three charges of the desired weight. Run them into your cartridge case, noting the height to which they fill the empty shell, and then scratch a mark a full sixteenth of an inch above the level of the powder. By means of a file or hack-saw cut your case at this point and smooth off the edges with a medium coarse file. With a little work the case may be filed down to the proper height, but it should be carefully tested during the final operation. The handle, made of a bent piece of stiff wire, can be soldered to the side of this cup if desired.

To use a charge cup of this sort, particularly with smokeless powders, requires extremely careful handling. The cup should be filled to its top level, extreme care being taken to prevent the powder from settling or packing into the shell. The surplus should be scraped off with a single straight motion, again using care to see that you *scrape off* the surplus instead of packing it into the cup. Although these charge cups have a reasonably useful field in the handloading game, the author suggests that the beginner do not attempt to use them but acquire instead a good commercial powder measure of the adjustable type. In the hands of a skilled operator, charge cups can be used with great success. In the hands of a beginner, they are quite likely to play some dirty tricks in the shape of variation of powder charges. In the hands of no one should they ever be used to measure out charges of any of the dense powders.

Adjustable Powder Measures. John M. Barlow, who founded the Ideal Manufacturing Company in the late '80's, designed and placed on the market what is believed to be the first practical adjustable powder measure, which, while it has undergone a few minor changes and improvements, is essentially the same today. When John Barlow came out with his measure it was the only practical instrument in the field. Today, despite the fact that it is one of our leading powder measures, it has a number of very excellent competitors, and several new ones are planned for the near future. At present there are at least six different makers of powder measures, all of which have some excellent features.

All powder measures are essentially alike in one respect: they all employ the gravity-feed principle. They are alike also in another respect: from a hopper or powder chamber they all run a fixed amount of powder into some form of metering

device having a fixed or an adjustable cavity. This cavity is exposed to the column of powder in the hopper or to its auxiliary feed chamber when the operating lever is placed in a certain position. Moving the operating lever to another position, ap-



The old reliable Ideal No. 5 powder measure, the oldest on the market

proximately 180° from the first point, cuts the metering device from the powder supply, thus leaving this cavity filled to capacity. When this is rotated to the proper discharge position, the powder is emptied into the discharge tube and thence into the cartridge case.

The majority of these commercial powder measures can be depended upon under certain conditions to throw charges as accurately as the loading machines in ammunition factories. They do, however, permit a great deal of the personal element to enter into their operation, and their accuracy is thus considerably tempered by the care and skill put into the process by the handloader. Some men can use certain instruments and achieve greater accuracy than others. The main point in using a powder measure is to take the job seriously, use the utmost of care, and learn the peculiarities of your individual instrument. Most of these measures can be made with the majority of powders to throw charges with a variation of not more than 1/10 grain. With several different instruments, representing all types of measures, however, the author, through deliberately careless manipulation, has been able to throw charges varying from one-half to two full grains. These tests were made deliberately in accordance with some of the ideas gathered while watching other handloaders handling their machines. The filled measures were mounted on a light bench, and the bench was jarred by full-length sizing of shells in hand dies, seating bullets in a B. & M. hand seater, and similar stunts employed between occasional charges. This caused a settling of the powder column, throwing an unusually heavy charge when the lever was in the "charge" position, as the column settled and packed into the metering chamber. When the operating handle was left down—in the discharge position—the packing of the powder at the bottom of the hopper frequently had a reverse effect and the following charge ran light. It is impossible, however, to foretell the nature of this variation. It can be produced by jarring the measure or the loading bench, or by leaving the measure idle over too long a period. Run your powder charges all at one sitting, if possible. If you have to leave the measure for a few moments, throw a dozen charges into a container to loosen up the column and get it flowing uniformly.

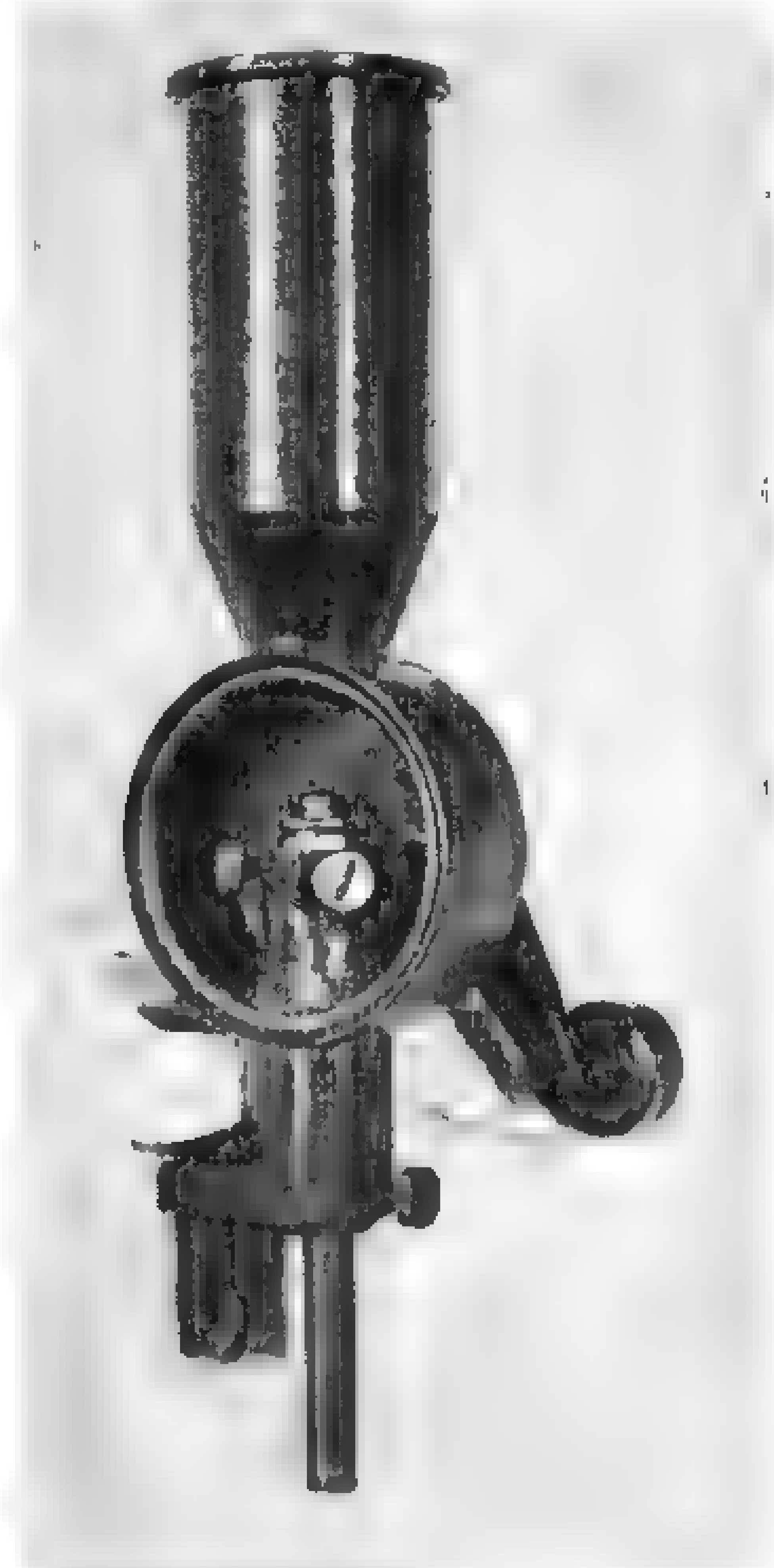
Most of the commercial powder measure manufacturers use a rotating drum or similar device. This type includes the Ideal, Bond, Frankford Arsenal, Comer and Truhon. The Belding & Mull is somewhat different, as is the Star. The former employs a hopper which feeds powder to a glass-front auxiliary chamber. Operation of a lever moves this chamber to the right, where the contents run through a discharge hole into a form of adjustable charge cup. The auxiliary chamber will hold in the vicinity of 200 grains of dense rifle powder. Moving this chamber disconnects it from the hopper, so that a constant weight of column is always present over the charge cup. This charging cup is held in the hand, pressed into the discharge tube, and when the auxiliary chamber

passes over it, the cup or measure is filled to the proper level. Releasing the lever returns the auxiliary chamber to the hopper to be replenished, and the charge tube is then withdrawn and emptied into the waiting cartridge case.

Latest version of Ideal powder measure—the No. 5 Micrometer. This measure does not prove to be as uniform on light revolver charges as on heavy rifle charges, owing to the micrometer arrangement

In many ways this B. & M. has proved to be a bit more accurate than the rotary drum types, particularly with coarse-grained powders. It is inclined to be more uniform because of the constant quantity of powder, and almost any level may be maintained in the hopper. In most measures variations as great as .2 grain, on the average, are noted with a filled and with a nearly empty hopper. With some powders the variation is greater.

The Star measure is not sold individually, but is a part of the two models of Star loading machines. This measure uses a straight tubular hopper with a false bottom giving the same effect of auxiliary powder supply, the contents of the main hopper feeding into this bottom chamber, where



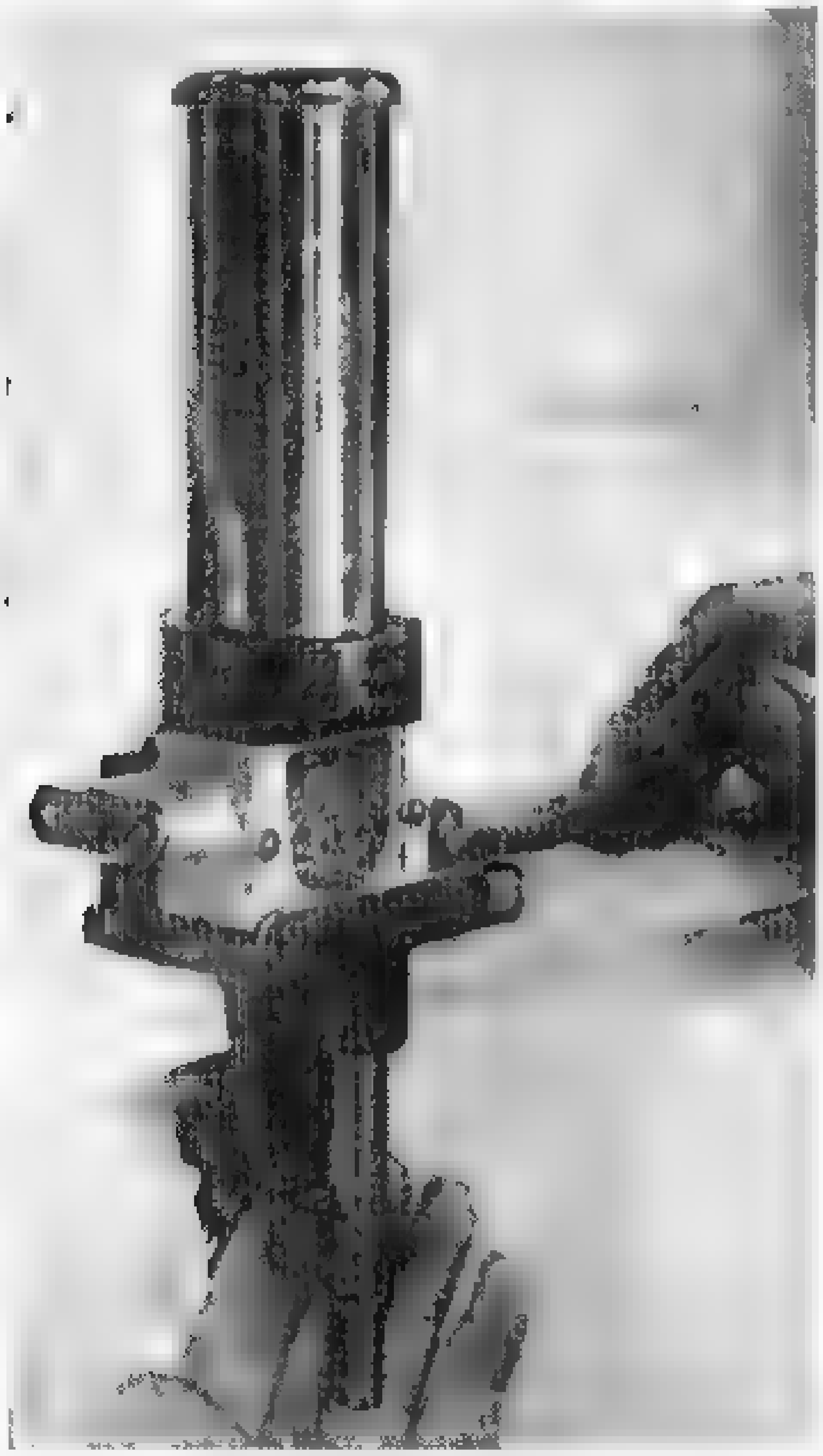
The Bond measure. Note revolving cylinder operated by crank. Metering chambers illustrated in the discharge position

pressure is not dependent on the powder column in the main reservoir. From this chamber it feeds into the metering chamber—a slide having either a fixed or an adjustable cavity, depending on the model. This slide moves forward to discharge into the case, and backward to refill from the auxiliary chamber.

The Bond powder measure uses a drum operating within the lower cylindrical body of the measure. There is a metering chamber built into it

with an adjustable bottom, thus enabling the operator to vary the size of this chamber at will. The Ideal type uses slides. Manufacturers of these three measures very clearly describe them in their own catalogs and no attempt will be made to discuss them in this book.

Non-Adjustable Measures. Another type of measure introduced in 1935 is the Comer non-adjustable, designed and manufactured by Paul

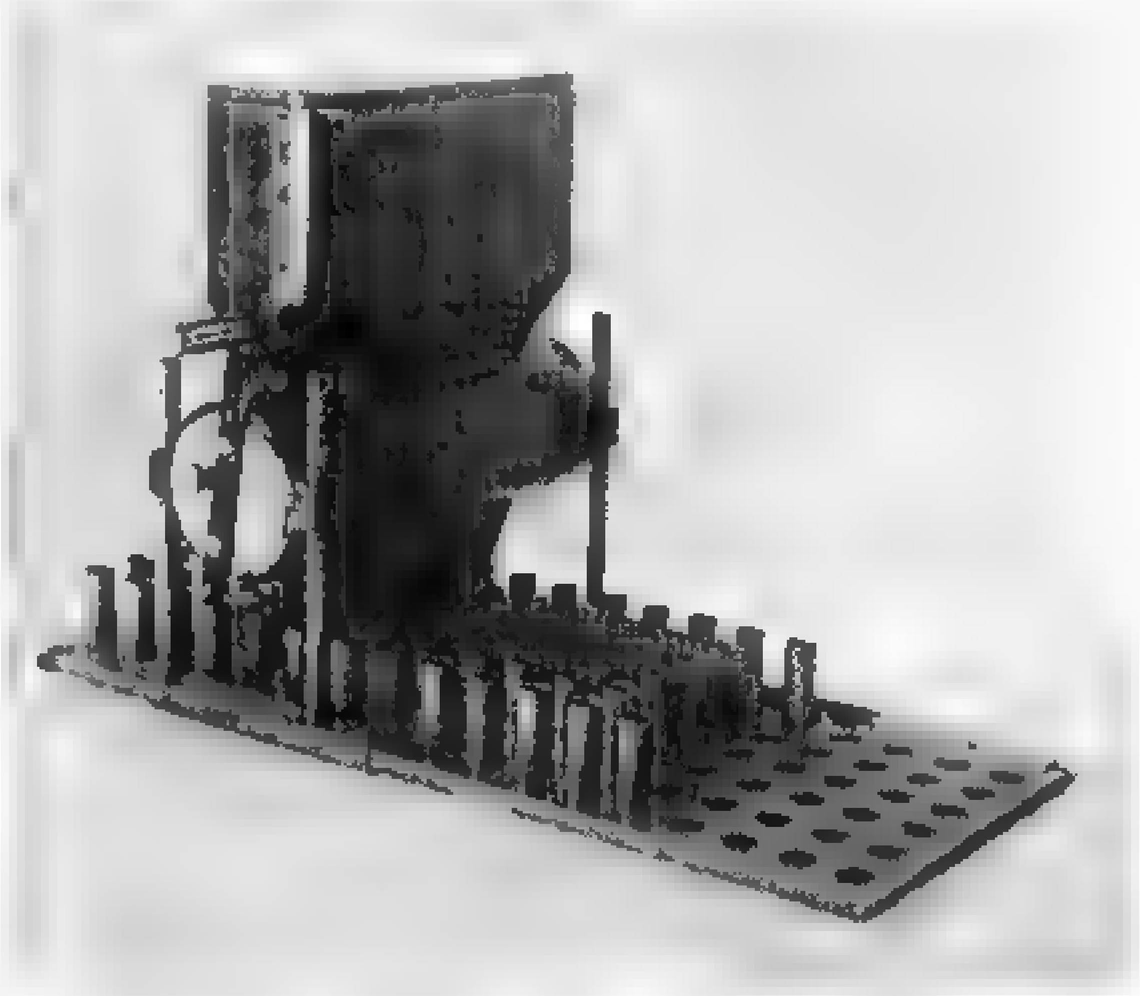


The Belding & Mull Visible powder measure. Note separate metering chamber held in position with the fingers

Comer, 111 Price Avenue, Narberth, Pennsylvania. At this writing Mr. Comer has no folder on his measure and accordingly it will be described here.

The tool is made of cast iron, but instead of the usual extremely raw inside finish of the hopper, this measure is carefully lathe-turned throughout its interior, leaving it perfectly smooth for proper feeding of the powder charge. The metering chamber is along the lines of the old Frankford Arsenal measure, except that the metering drum is non-adjustable. It is made of heavy Tobin bronze with the powder cavity drilled for a very definite charge and to order. Thus there is no adjusting of the measure or constant checking against your balance every time you use it. The kind of powder and weight of charge for which this drum is designed are stamped clearly in a conspicuous place. Additional drums are always available.

Paul Comer is an experienced handloader, and in designing his measure he clearly demonstrated that he understood the problems before him and recognized the one weak point of every powder measure on the market: It would seem that all powder-measure makers have somehow labored under the false impression that the handloading clan is a group of "south paws." Apparently their measures work better for a left-handed person than

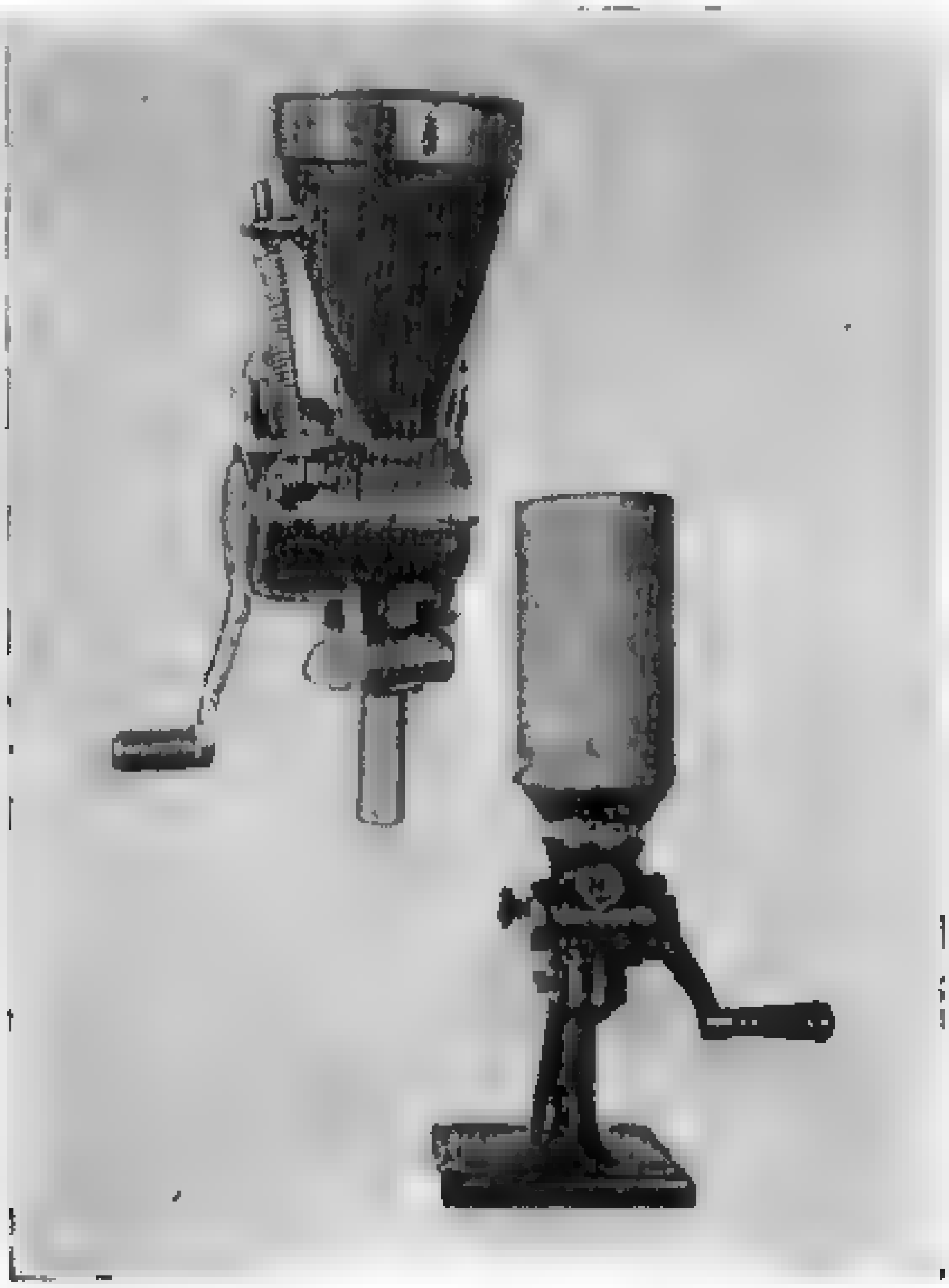


The Truhon multiple measure throwing six charges at one drop

they do for the average man. It may be all right to hold your shell in the left hand and operate the handle with the right. This is really not very difficult. The average man, however, is better able to do the work if he operates the measure *handle* with his left hand and uses his right for the more delicate job of holding the primed shell in position to receive the charge and place it in the loading block to await bullet seating.

This left-handed operation is extremely annoying with one of the author's best-liked powder measures—the Belding & Mull Visible. To use it you hold the metering tube in position on the measure with your left hand (see illustration). You operate the handle with the right. You then remove the tube with the left hand, let go of the handle with the right, pick up your shell and some sort of funnel with the right hand, and pour the

contents of the metering tube into it. It is surprising to see how awkward this left-hand pouring operation really is; the charge of powder is frequently spilled in the process. Spilling the powder



Top: The Comer measure. An excellent and extremely uniform type. This is about as fast as any measure the author has ever tried. Bottom: The old Frankford Arsenal powder measure with the funnel hopper removed and a straight cylinder hopper used in its place

charge is not serious, but spilling a powder charge on a half-filled block of properly measured charges is extremely disconcerting and necessitates the emptying back of *all* charges and doing the job over again to insure uniformity. The ingenuous operator can, by means of a bit of work and the manufacture of an off-side handle, convert this measure so that the operating lever is moved to the left side of the measure, thus permitting the measuring tube to be held in the right hand. If this is done, running powder charges into the shells without spilling is made much easier.

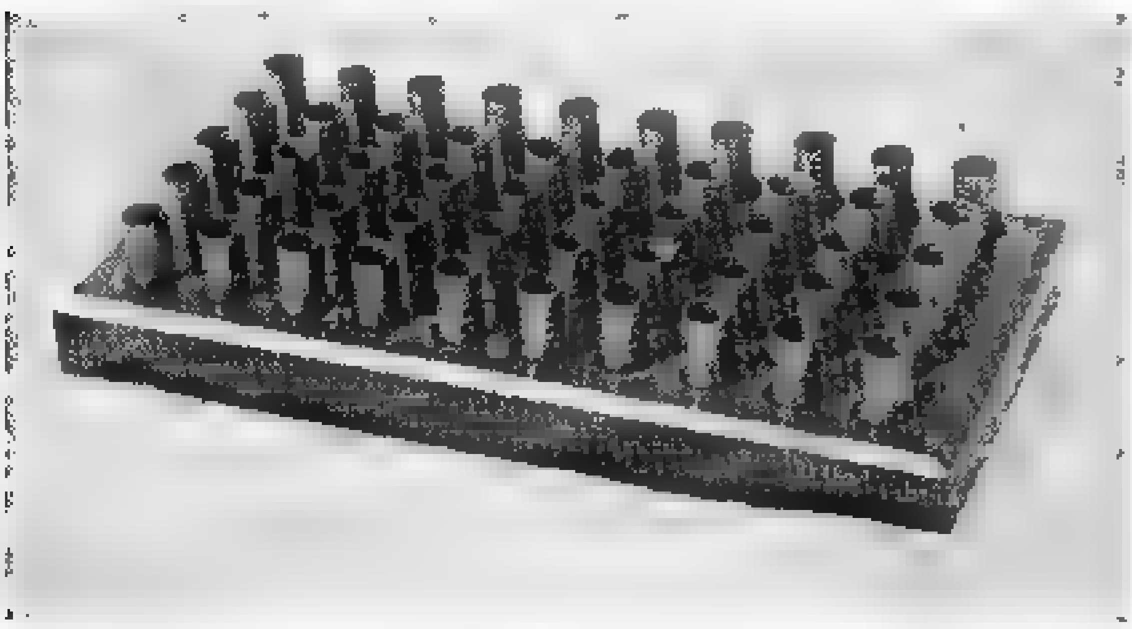
Comer has overcome this problem by placing his operating lever on the left side of the machine. While there are a few minor features which may possibly be improved upon, Comer's measure is the best tool ever developed for speed loading; and, what is more, it will deliver uniform accuracy at this speed. Using two loading blocks, each filled with 50 .38 Special shells, the author has repeatedly measured a standard charge into these 100 shells, working steadily but not carelessly and being checked by a stop watch at 3½ minutes average for 100 charges. The minimum time for 50 carefully measured charges has been 1½ minutes. No other powder measure will give anywhere near this speed.

A handloader in watching this operation insisted that charges could not run uniform at such a speed. At the time I was running an experimental 12-grain charge of Hercules #2400. Fifty charges were thrown in 100 seconds flat. These were then weighed on a balance sensitive to .001 grain and with Class "S" Bureau of Standards weights. The first ten charges thrown (in handling powder measures I always throw at least five charges which never enter shells) and the final ten were carefully weighed by means of a rider on the beam to less than .01 grain. Maximum variation for any of the charges with this powder measure ran .07 grain. It is sufficiently uniform for the finest of target accuracy. With charges thrown with this measure and loaded into the

A homemade powder measure which works fairly well for throwing handgun charges. The upright portion is clamped in a vise or attached to the side of the loading bench in an upright position by means of screws. The measure was built from odds and ends by a dentist

Hornet with the special Springfield Armory Z-2 bullet, one-inch groups rest-shooting at 100 yards have been obtained, which is as fine as I have been able to get with any weighed charges.

I think that the uniformity of this measure is partially due to the polished inside of the hopper and partially to the fact that Comer has built into the machine an automatic knocker, spring operated, and controlled by the movement of the operating handle. This knocker taps the hopper at the moment the powder charge is run in the drum cavity and taps the discharge tube at the instant of its discharge, thus making sure that no powder remains in the cavity or tube. Owing to its design, this knocker hits a uniform blow regardless of operating speed.



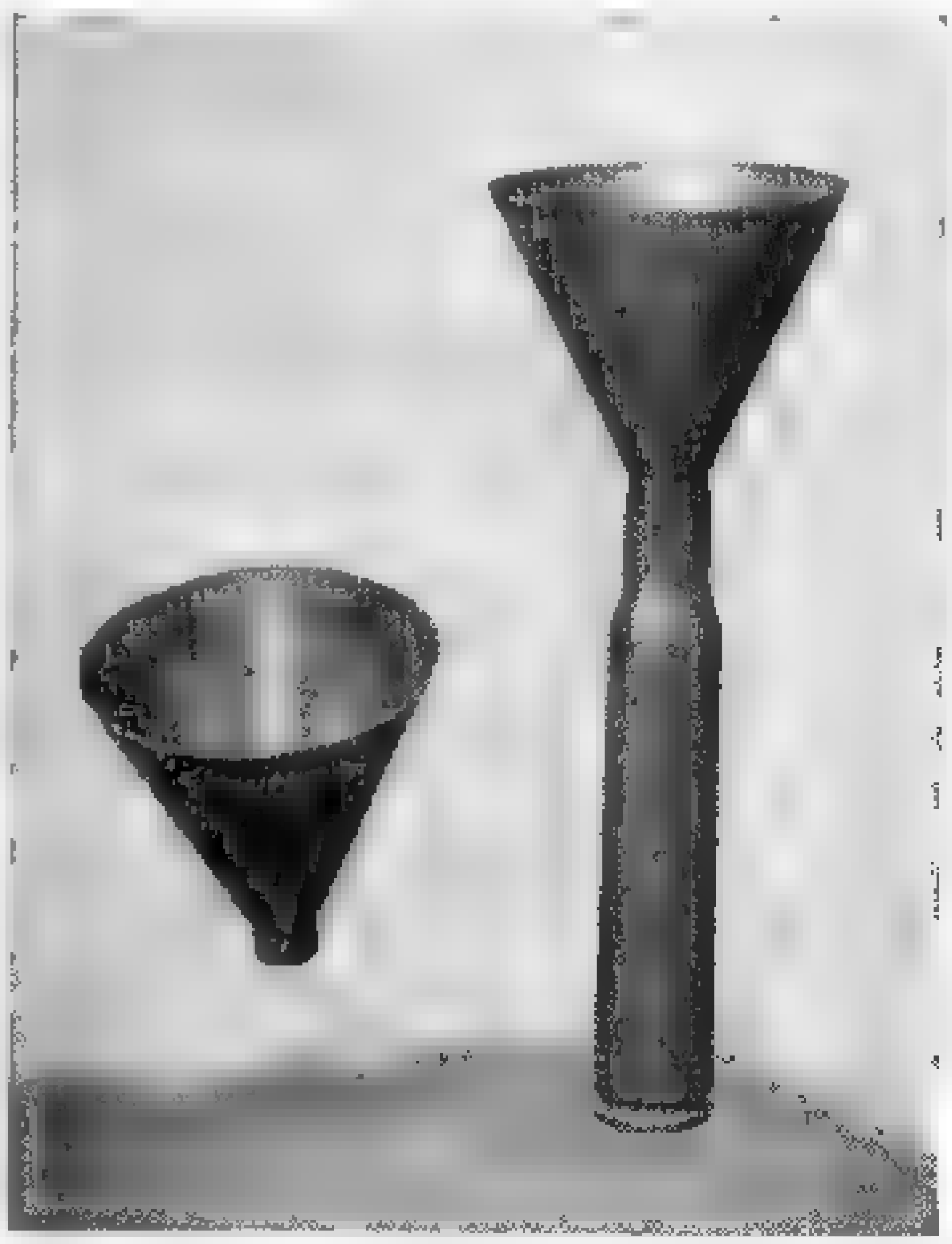
Loading blocks are an absolute necessity whether charges be weighed or measured. It is easy to make them from a block of wood. Holes should be bored to a uniform depth. Many loaders bore completely through the block and then glue to the bottom a thin sheet of wood or very heavy cardboard

Multiple Measures. Another measure that was prominent ten years ago was produced by John A. Truhon of Detroit. This machine would throw six charges at a time and was adjustable through a reasonably wide range, although it was designed primarily for speed in reloading handgun cartridges.

The first measure that Mr. Truhon sent me for test was made entirely of aluminum—aluminum body and hopper, and aluminum drum. The long drum had six powder cavities with an adjustable bottom of brass plugs controlled by means of a gear nicely fitted. The idea was excellent but the construction was poor. Aluminum is as soft as any usable metal and will wear rapidly and score easily. We went over these ideas with the designer and he immediately set to work on a new model which he sent through in due time. Accepting the author's recommendation, he made the body and hopper of cast iron and the metering drum of bronze. This model was superior to the other, although built in identical dimensions. Tests showed that it would throw about .8 grain of Pistol #5 and the same amount of Bullseye when set at the minimum adjustment. It could be quickly set by means of a pointer on one end of the operating gear at any desired charge up to 18.1 grains of #5. At this setting the maximum charge of Bullseye was 19.6 grains, indicating plenty of room to accommodate all handgun cartridges.

Truhon also sent along a similar drum of non-adjustable type which could be interchanged with the adjustable form. It has nothing in its favor other than being more fool-proof by being non-adjustable, and we would recommend that the adjustable type be used.

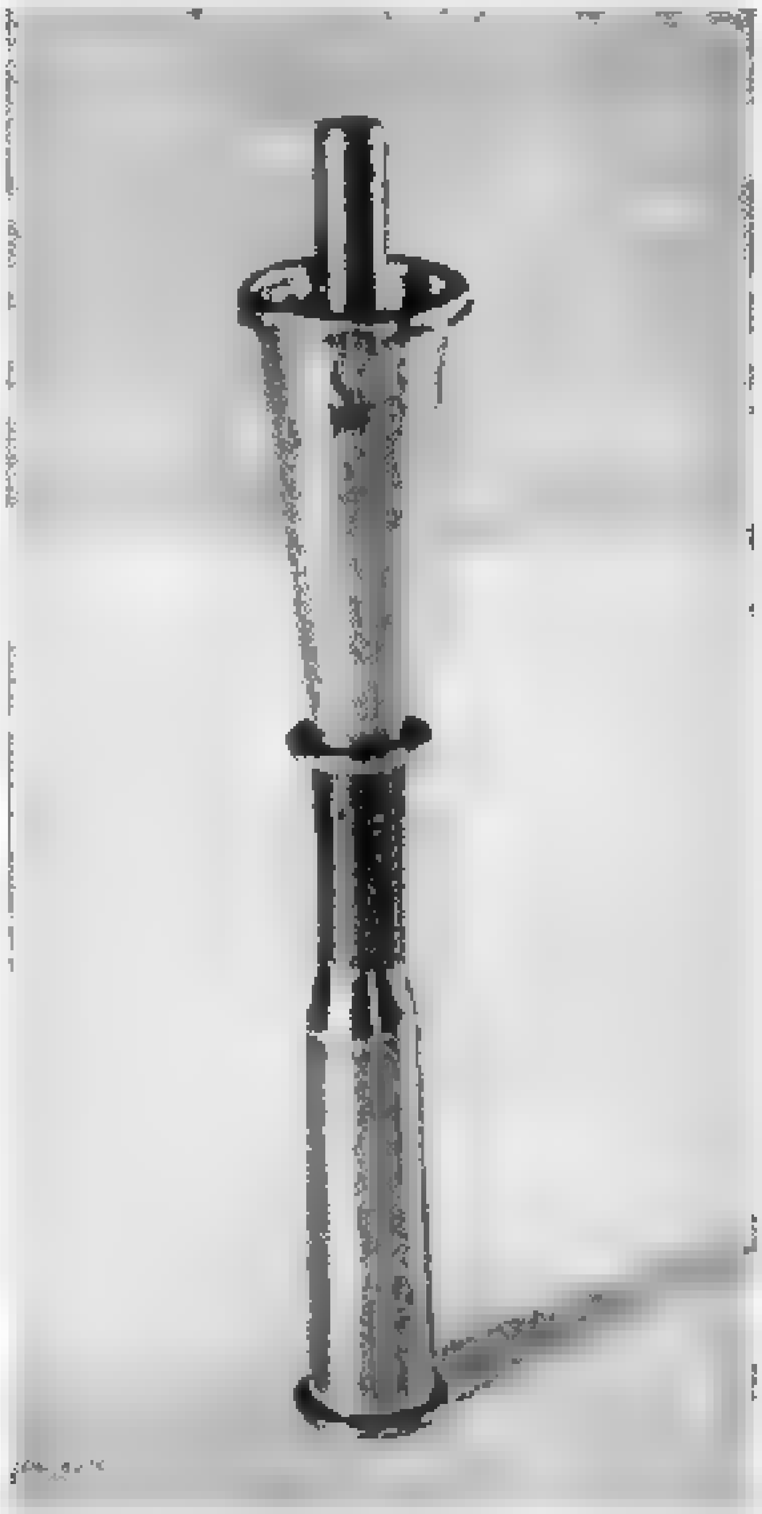
The measure is supported on a special base made of heavy sheet brass and is attached to four uprights. A loading block containing rows of six shells is held beneath the measure, which is adjusted in vertical positions so that its discharge tubes just clear the mouth of the shells. Operating the handle discharges the powder simultaneously from the six half-inch cavities in the metering drum through these individual tubes. For best operation the measure should be attached to the bench by means of screws.



The Belding & Mull powder funnels are extremely useful in running the charge into the cartridge case. Sizes are available to fit any caliber of neck

With this measure comes a special loading block designed by Truhon. It holds 102 .38 Special shells in rows of six each—17 rows. A sheet of heavy brass has these holes properly punched in them, the sheet dropping into another heavy sheet-brass tray. This sheet is then turned upside down and the shells dropped in from the bottom, the

holes being bored to proper size so that the rim will not permit them to drop through. The tray is then placed over the shell heads and the entire unit reversed so that the shells remain mouth up.



A useful kink: Getting more powder into a cartridge than its normal "capacity." The slender hopper fits over the outside of the shell neck and powder is gradually run into the shell. The tamping rod is then dropped in and the head of the shell tapped lightly a few times on the bench. The weight of the rod causes the powder to settle more uniformly and occupy a minimum of space. Photo is of an outfit belonging to Harvey Donaldson, noted shooter and writer. The idea is not new, as Harvey tells me it was given him about 1895 by the late Rube Harwood, noted experimental shot and master marksman of yesteryear

In this position the shells are quickly filled, whereupon the perforated sheet is gently lifted off to leave neat rows of cases on the tray ready for the seating of bullets.

The major trouble with this measure in the original models we examined was variation in powder distribution from the hopper into the six cavities of the 1¾-inch bronze metering drum. It is believed that Truhon has cured this fault by means of a newly designed inserted distributor in the hopper; if so, he has developed a very excellent measure.

Pacific Non-Adjustable. The most recent addition to the powder measure field is the Pacific Non-Adjustable, brought out early in 1937. This measure has some very excellent features, chief of which is the surprisingly low price for an instrument of quality.

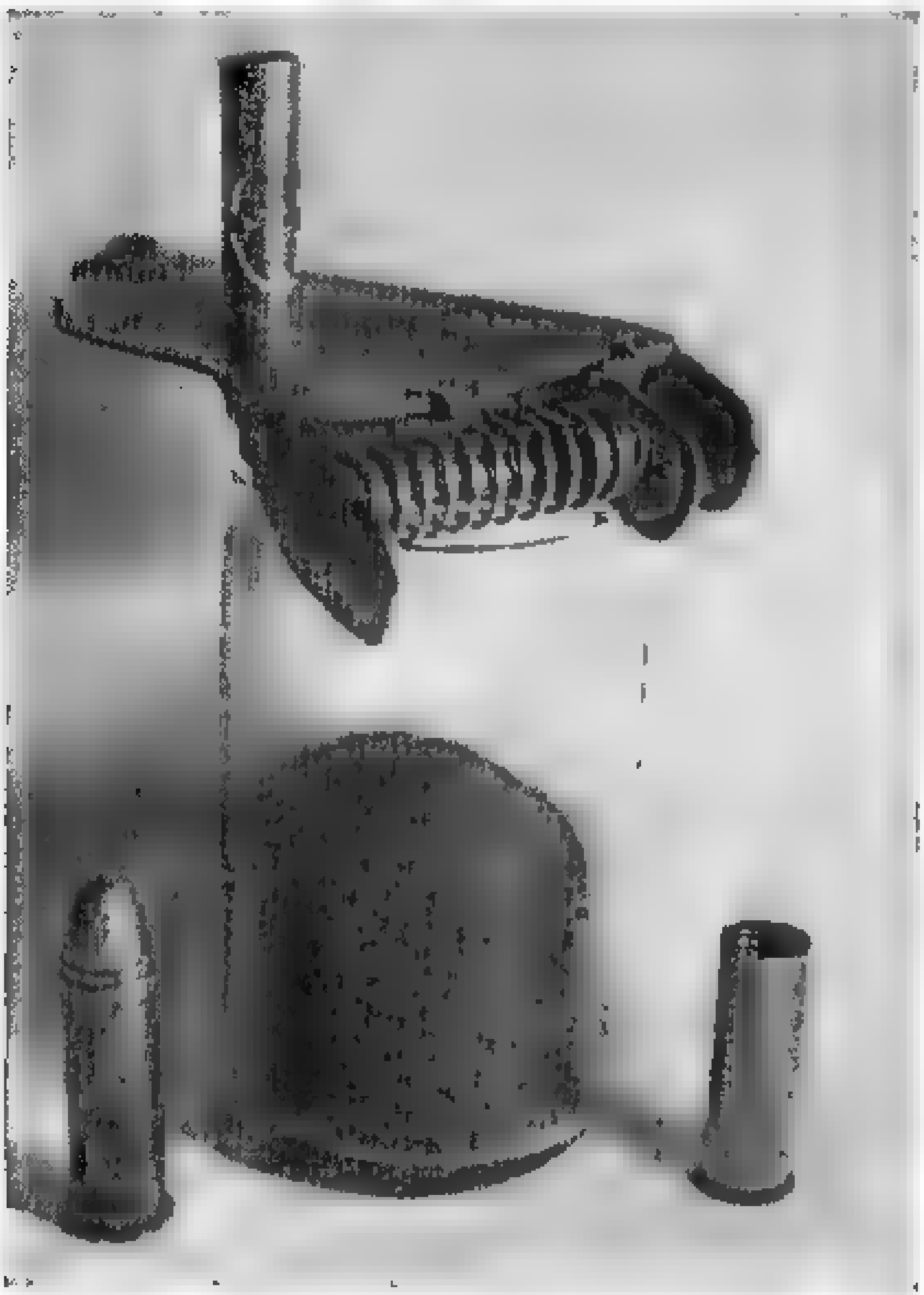
In design the Pacific uses a cast-iron base fitted with clamp screw for attachment to a bench top. As in other conventional tools on the market, this clamp screw has a capacity of only one inch—not sufficient for attachment to a thick bench top. Toolmakers seem to think that handloading is all done on the kitchen table—or on some discarded bureau. A one-inch hardwood board screwed or bolted to the bench top and having a slight overhang will accommodate these clamp-on instruments neatly. Some day measure-designers will wake up.

Homemade powder measures designed by A. J. Weinig, Golden, Colorado. Small mayonnaise jars are altered to drop proper charges directly into shell

The body of the measure or hopper is a drawn brass tube 4 inches high and 1⁵⁄₁₆ in inside diameter. It holds sufficient powder for successful loading with either rifle or handgun cartridges, al-

though it is designed chiefly for the handgun numbers.

The metering drum is a brass or bronze rod properly turned to fit the cast-iron base, and instead of having a handle for the necessary 180° rotation, the projecting end is coarsely knurled, making it very easy and rapid to operate. The amount of the charge is marked on one end of



Close-up view of Weinig unit for measuring charges. Note adjustable metering tube

this metering drum and cannot be varied since it is predetermined by the depth of the charge hole bored into the rod. Additional drums can be secured at small cost for any desired charge.

Suggestion: In playing with this accurate little measure—it meets the requirements of all tests and is the equal of many others on the market—we tried to speed up the operation and accomplished this in two ways:

The first was simple. A foot treadle was made of a section of wooden box cover, and a piece of wrapping cord attached to one end opposite a simple hinge. This treadle was attached to a large slab of wood and placed on the floor beneath the measure. The cord was then carried up to the measure, looped around the knurled operating knob several times, and carried back, down to the treadle base, where it was attached to a flexible coil spring. Slight pressure on the treadle rotated the metering drum to discharge the powder. Release of this pressure caused the spring to return the drum to receive another charge from the hopper. A few moments of experimenting with this makes one quite adept, and the work is greatly speeded, as one has both hands free to handle shells. If it doesn't work, unwrap the string and the measure is "as was."

Another of these measures was altered by cutting a series of simple teeth in the knurled portion, and a short section of flat rod was also fitted with teeth and built into a holder to form a "rack and pinion" method of operation. This rack was backed with a light spring and the measure operated by thumb pressure to discharge. The rack and pinion idea was contributed by E. C. Dyer of Portland, Maine, while Stanley Mayo, also of Portland, suggested the simple and speedy treadle system of operation.

All in all, this Pacific is the lowest-priced measure on the market, and is well worth the price. It is, of course, a product of the makers of the Pacific loading tool.

OPERATION NOTES

Regardless of the type of measure you use, there are a few little tricks in handling which can well be understood. Uniform measured charges can result only from uniform operation of the instrument. If you intend to use your measure to run 50 charges of powder, do not fill the hopper until you are ready to begin. Then throw from five to a dozen charges into a small pasteboard box, which, of course, may be emptied back into the hopper again. Always do your measuring with a slow, steady, uniform wrist and elbow movement, never jerky or careless. The greatest accuracy is obtained only by simplifying all movements, working out a system, and adhering closely to it. If you can readily operate your measure at a speed, for instance, of 15 charges per minute, always try to maintain that particular speed. Do not try to rush it, and do not slow down. Contrary to expectations, excessive slowing down permits variation in the settling of the powder column with a resultant effect upon the amount of the charge thrown.

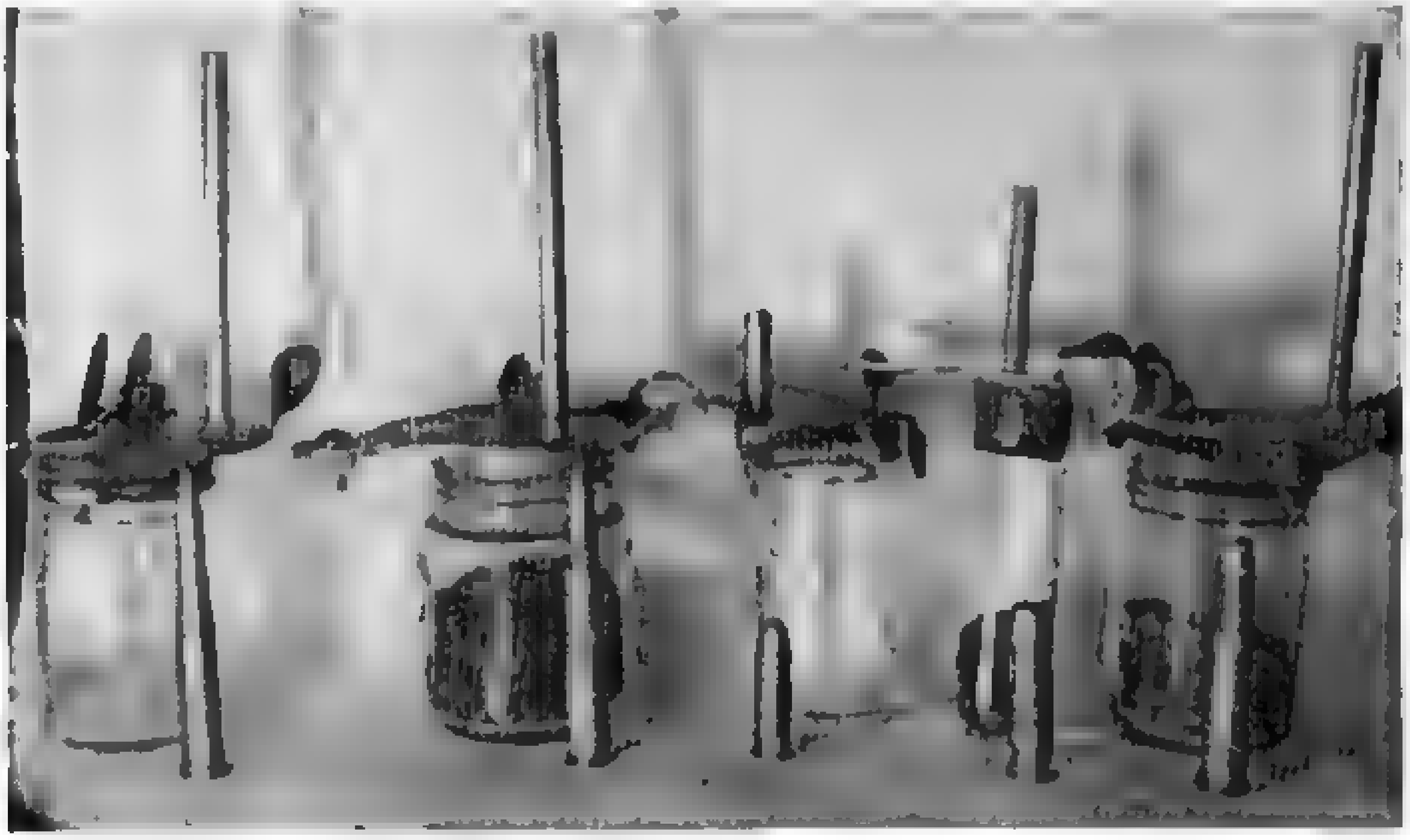
Always maintain a uniform level in your hopper. Keep it replenished at regular intervals, these intervals naturally depending upon the kind of measure and the weight of the charge thrown. It

is, of course, necessary to replenish the supply far more often when throwing a 40-grain charge of rifle powder than when throwing a 5-grain charge in a handgun load. It is also well to bear in mind that after replenishing your powder supply in the hopper, at least a half dozen charges should be thrown and discarded. An empty 12-gauge shotgun shell box is extremely convenient to catch these waste charges. It should be set beside the operator, and if he accidentally uses a jerky movement instead of the steady uniform one to which he is accustomed, the contents of that shell should be emptied into that box and the charge re-thrown before the case is placed into the loading block.

This same empty box, if held beneath the charge tube, will catch all surplus powder when you desire to operate the handle a few times to stabilize the machine before throwing charges for use.

Uniform Charges. Some operators prefer to tap the powder measure either on the hopper or on the discharge tube, or both, to insure "uniform" settling and discharge of the powder. The author does not consider this a wise move except with an extremely skilled operator who knows his own measure well. Variation in the force of the tap may produce a corresponding variation in weight of the charge thrown. It should be clearly pointed out that there is a tremendous difference in powder measures even of a certain make. This difference is more in the matter of filling than anything else, but it is extremely important that the operator learn his own machine and stick carefully to it. One would not expect a skilful shooter to enter a match with a borrowed Springfield National Match Rifle and shoot as good a score as he would with an identical specimen which he has shot extensively and knows well. Mechanically there might be no difference—even the trigger pulls might be the same—and yet the scores would be somewhat off with the strange gun.

The same is true of a powder measure. The author demonstrated this to a fellow handloader not long ago with surprising results. He threw ten 15-grain charges, using a measure with which he was familiar. He had used this measure for several years and knew its peculiarities quite well. He also knew which powders would handle perfectly in that measure and which powders would perform better in one of his four other measures. Accordingly, when a skilled handloader called upon him, he decided to test out the personal element.



Assortment of homemade powder measures by Weinig, with various shells. Each one adjusted to throw a particular charge

This particular combination of powder measures will throw as uniformly as anything we have ever seen in any form of powder measure. Ten charges were thrown by the author. On weighing they showed a maximum variation of .04 grain, an average variation of .03 grain. Believe it or not, this accuracy is possible with *some* measures with *some* types of powder and indicates the possibilities of a measure with which one is thoroughly familiar. This other chap was then asked to test his skill on the same load with the same setting. He was given 10 charges to discard to "learn" the

measure and then ran an additional 10 for record. On weighing these, the average variation was .12 grain. This does not necessarily mean that he was less skilled than the author, but that he was *unfamiliar with my particular measure*. This is mentioned as a suggestion to all handloaders to learn their individual instruments thoroughly.

A mistake frequently made by handloaders is to mount the powder measure on a table along with their bench-type loading tools; throw a few

Close-up of metering tube on homemade Weinig powder measures. Note scale lines filed into tube to permit adjustment for different weight charges

charges, and then shift to the seating of bullets, leaving the filled measure to absorb the vibrations of the loading tool. There is no more certain method of producing variable loadings than this.

Several years ago, while on a visit with that ardent experimenter and handloader, A. L. Woodworth of the Springfield Armory Experimental Department, Al pointed out the necessity for using the greatest of care in this. Woodworth is one of the designers of the Hornet rifle and cartridge and has probably developed more bullets and loads for this combination than any other individual with the possible exception of Captain Woody. Al both weighs and measures his powder charges and has obtained phenomenal accuracy with handloads merely because he knows how to use his instrument and applies that knowledge each time he handles it.

"You should tell handloaders, both experienced and beginners," he once told me, "that the use of a powder measure mounted on a loading bench is extremely unwise unless you do all your measuring before you seat any bullets. Unless you obey this law rigidly, it is frequently possible that with certain set-ups a charge may be thrown as much as .3 grain overweight, which, while it may not be disastrous from a safety standpoint with some loads, is certain to make a great difference in the point of impact. Accurate powder charges merely mean uniform charges, and uniform charges—all other features being equal, particularly with regard to a good rifle, properly selected bullets, and good cases plus good holding—mean uniform point of impact. This, in the final analysis, spells accuracy."

No reloader should depend on setting an adjustable powder measure by using the tables for these settings published in the manufacturers' catalogs. These tables are not exact and are not intended to be so considered. They are merely guides to simplify the setting-up process. It is a good plan for the handloader to check his settings by weighing several charges with the proper powder balance and making the necessary corrections in the measure to produce the proper load. He should also arrange to check on charges frequently to be sure that the adjustments have not slipped. The loading block should always be used to hold the filled cartridge cases, and if this block is illuminated properly, the contents of the cases may be inspected for uniformity. If one appears to be too full or not full enough, take no chances. Discard it and remeasure the charge. Powder measures are also extremely convenient for the operator who is weighing maximum charges. He may set a measure up ½ grain less than the desired charge and then empty his charge directly into the movable pan of his balance. A sufficient amount of additional powder may readily be added to speed up the operation.

No maximum handgun or rifle charges should ever be measured. In this respect, only the greatest of care and reasonable skill in the handling of a powder balance should be employed. Maximum loads make maximum pressures. Maximum pressures have a way of approaching the danger point with very little provocation.

Without a question, the development of the gravity-feed powder measure is the greatest boon to handloading yet discovered. You can learn much from using one. Use care, learn your measure, and you will get much more fun with less of the tedious problem of weighing charges if you have a suitable instrument. All forms on the market are satisfactory after one has experimented

with and learned the weak points of his particular specimen. One soon learns that the finer-grained powders work better and throw more uniform charges than the heavy, coarse-grained forms. H.Vel #2 is the most difficult powder to measure, as it happens to have the largest granulation found in any small-arms powder now on the market. By the same token, extremely fine-grained powders in heavy charges are difficult to measure, since they have a habit of settling or "packing."

Coarse powders require more brisk tapping of a measure, since they are inclined to bridge. Kindling wood can be "carelessly" stacked in a basket in such a way as to give the impression of a well-filled container. A bit of shaking causes the collapse of the stacked wood, and it settles into the basket in such a way that a good deal more may be added to fill. This is identical with the action of coarse-grained powders and explains the necessity for tapping the hopper or discharge tube. . . . Always use a discharge tube as large as possible with the cartridge case in question. Of course a smaller tube is necessary with .25-caliber cases than with the larger bores. An extra-large discharge tube may be used if a small funnel is used over the mouths of the cases. . . . Inspect these discharge tubes each time you use them, and make certain that there are no cobwebs, dust, or other débris which might cause partial stoppage. Push a dry cleaning patch through to dispel all doubt. For large or heavy charges, use a long tube, as it permits of better packing in the shell.

And for safety's sake, *work alone* when weighing or measuring powder charges. You are less liable to make a mistake if there is no conversation to distract your mind. You will find it an excellent aid to safety and accuracy if you will occasionally check a charge by weighing it. For best results, check every tenth charge. This may tell you that something has slipped in your set-up and you are now throwing charges weighing much more or less than the load demands. If you use a loading block, with your filled cases properly lined up, it is easy then to trace back and locate the point where the trouble began. Throw back all charges thrown since this point.

A powder measure cannot be made by its makers to throw "accurate" or "uniform" charges. That is the problem of the operator. Any handloader will find a practical use for a powder measure, and he will do well to use it extensively to familiarize himself with its operation. Many handloaders who take the game seriously, practice throwing charges and checking their uniformity against a suitable balance. This is excellent experience. If you have thrown a thousand charges, using your best efforts toward uniformity, and still can't get good results, *then* is the time to discard that measure. Usually it is just a case of "getting acquainted" to get results.

XXII

COMMERCIAL LOADING TOOLS AND THEIR USE

THERE are just three important necessities for the intelligent handloader: (1) A firearm to shoot. (2) The necessary components for assembling handloaded ammunition. (3) Tools with which to assemble them. A complete reloading outfit is an item of considerable expense, and yet it is by no means necessary to expend a great deal of money in acquiring satisfactory equipment. The greatest collection of precision apparatus ever assembled will be a total loss in the hands of an unintelligent operator. At the same time some of the crudest-looking specimens of home-made equipment can be made to develop true precision handloadings, equal to the finest factory match ammunition. It is entirely a matter of skill and intelligent handling.

The author suggests that the beginner in handloading buy the cheapest tools he can acquire for his initial experimental work. As he acquires skill, along with it will come ideas of his own and he will gradually assemble a collection of loading tools to which he will continually add.

My good friend C. R. Edwards, down in Chester, South Carolina, has for some years been an ardent handloader. He asked me for data on loading tools one day, and I frankly told him that if he was as bright as I assumed, it would be unnecessary for him to expend a great deal of money in the purchase of special equipment, and so Edwards got busy. He wasn't elaborately equipped with a machine shop, as he explained apologetically, or he would develop "better" tools than he now has.

His first problem was the resizing of .45 ACP cases for his .45 Model 1917 revolver. He acquired, in poking around for odds and ends, an old-fashioned plug-tobacco cutter and this formed the basis for the construction of his shell resizing outfit. He then located a Ford generator bearing and forced his .45 ACP shells through the hole in the center of the bearing by means of a punch, welded by a mechanic, in place of the old cutting knife. The whole thing is mounted so that the hand beneath it will catch the shells as they are pushed through.

Incidentally, he uses this same outfit with various resizing dies for his ordinary cast-bullet resizing. Not a reason in the world why it would not work. And not a reason in the world why some other ambitious handloader without the necessary funds for an elaborate bench press, shouldn't also acquire something similar and add the necessary finishing touches.

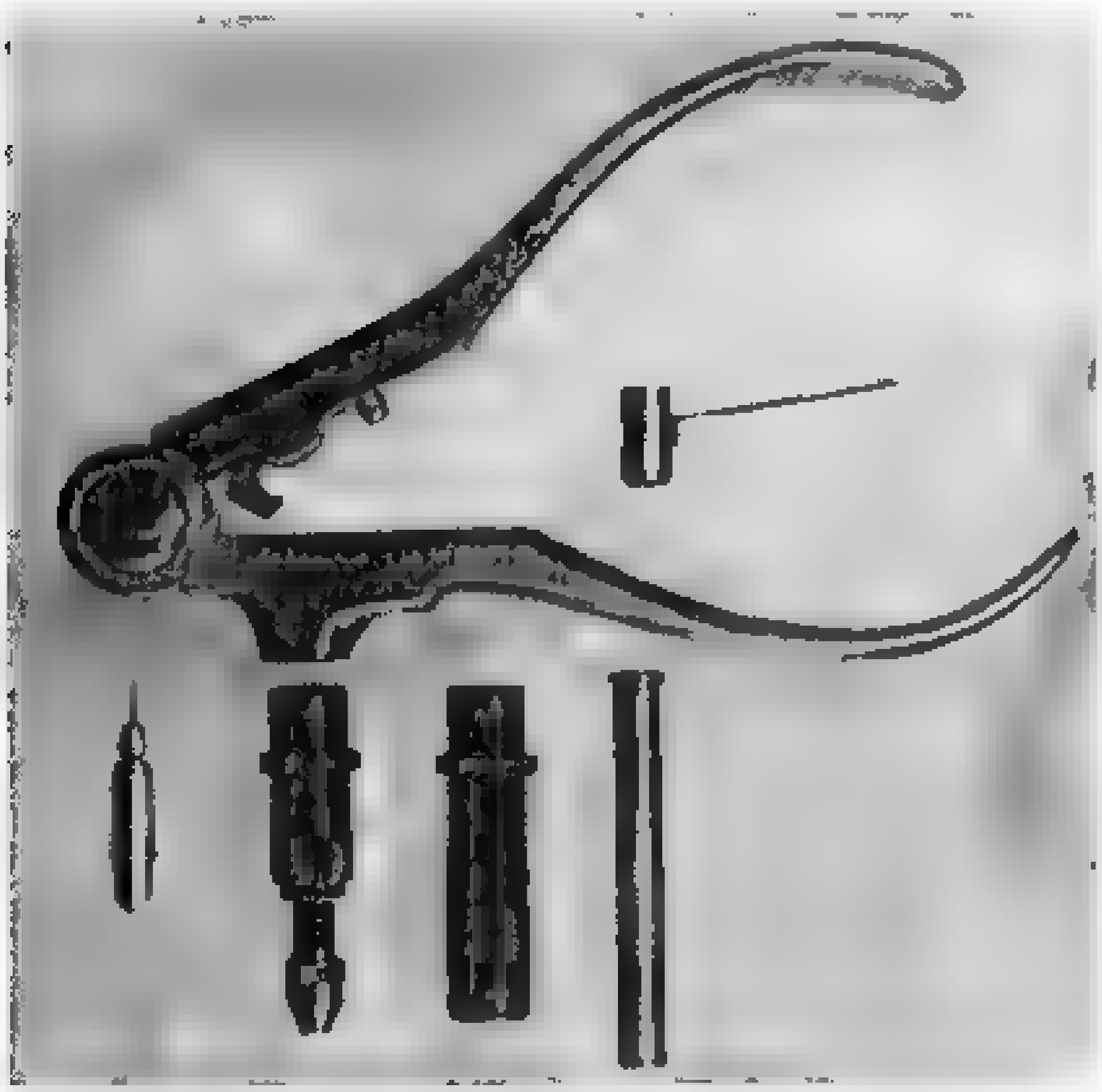
Came the problem of decapping and repriming of shells. There is no particular reason why Mr. Edwards' tobacco-cutter outfit could not have been altered with interchangeable equipment to take care of this problem. Instead, he continued his search and located one of the old-style rarely used brake-relining tools—the hand-riveter type. He picked this up in a corner of some garage and paid a few cents for it. He then took it home and fixed it up so that a single downward movement of the riveter handle would punch out primers quickly and accurately.

A mechanic friend also fixed this up in such a way that it can quickly be turned into a recapping outfit, and as Edwards writes, "It works slick."

The powder measure problem was something else to be solved. This is illustrated elsewhere in this chapter, and at a glance one sees a neat and thoroughly professional-looking outfit. Let's analyze the way it was built: The hopper was made of a large brass tallow cup from an old steam engine. The body of the measure is a brass bushing 1¾ inches in diameter by 2 inches long. The rotor is of solid brass. One end of the body of this measure is enclosed by soldering a brass disc to the bushing. The rotor proper has a short shaft which projects through this closed-in body. It is held in position by means of a washer and a cotter pin. The body at the opposite end is partially cut away so that the rotor may be given exactly one half-turn, whereupon a pin set into it will strike against the stop surfaces.

The adjustable feature of this measure is a half-inch reamed hole half-way through the rotor—but let's let Edwards describe it himself: "A screw plug is made with the head a lap-fit in the half-inch hole. It has a stem one-half inch in diameter, threaded 28 to the inch. A hole is bored into the bottom of the cavity, tapped to fit, and a stiff spring placed under the head of the screw plug before insertion. This spring provides sufficient

tension to take up minute slack in the threads and to prevent the measure from accidentally getting out of adjustment. With this combination I find that one turn equals about ½ grain of #5 Pistol powder, and this is quite sufficient.



An always popular tool: The Ideal tong type with double adjustable chambers. The above tool is designed for the .38 Special

"You have to check it more or less against a balance to get your adjustment, but it is really quite easy and is done without disassembling the units. Merely pour the powder out of the hopper and turn the measure upside down, whereupon a screw driver may be inserted from the bottom to make the changes. If you must keep varying your load, there is a bit of work to this adjustment; but if you use the same load all the time, there is not much to it and it holds its adjustment well."

There is just one thing about a home-made measure which slips the mind of a great many gun bugs. No matter how you design it, there must be no corners or crevices or rough places in the hopper, feed tube or discharge tube to collect even tiny quantities of powder. One chap sent me a home-made measure to test out. It was set when we received it to throw about 20 grains of #80 and in making a careful test of the unit we found to our sorrow that every fifth or sixth shot, the measure would commence to taper off, dropping as low as 17 grains, whereupon the following charge would hop up to approximately 23 grains.

The error was in his system of discharging the powder. Small quantities collected in corners from each charge, building up slowly, and reducing by an equal amount the weight of the charge going into the case. When the accumulation had piled up to a certain point it was automatically dumped with the next charge into a cartridge case. We sent this measure back, together with our suggestions, and instead of breaking the designer's heart, received a typical gun-bug letter in return.

"I delayed in answering your letter of the 20th," he wrote, "as I have been quite busy the past two weeks. Under separate cover I am mailing back that measure which you so kindly returned to me, and thank you for your suggestions. I have fixed it." He did fix it. You just can't lick the ambitious handloading fan.

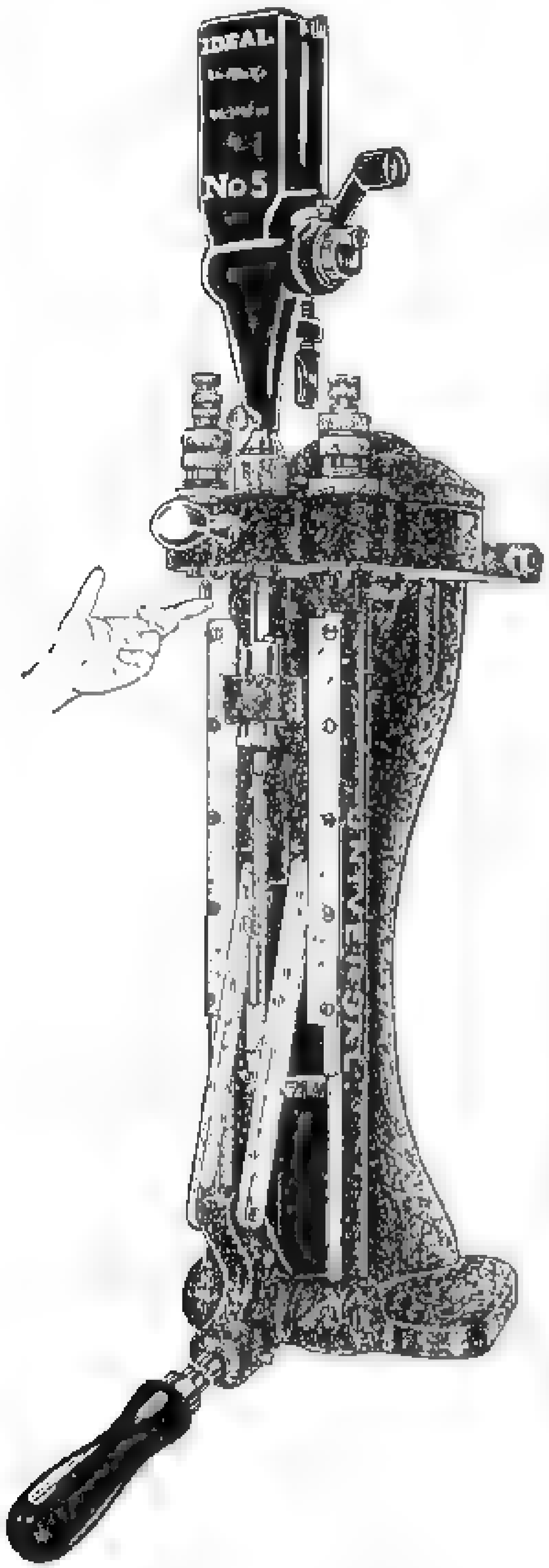
On the other hand, Edwards states that his powder measure throws unusually uniform charges, varying no more than the standard factory measures. We can well believe this. All powder measures are essentially of the gravity feed type. There is no particular reason why an entirely new *appearance* should not be given a powder measure. Before this book sees printers' ink, Edwards will have designed a number of new gadgets and attachments for his home-made loading set. We

Ideal tong-type tool designed for military rifle cartridges of the rimless type. Adjustable chambers

rather suspect that he does this because he likes it. Another case where the gun-bug fever is more important than the pocketbook.

Incidentally, when we asked Edwards for a photograph of his outfit, he dropped in on H. O.

Nichols, commercial photographer, of Chester, South Carolina, and asked him to come out and take a picture. It didn't take long for these two chaps to discover that they were both gun bugs;



U. S. Patent No. 2004420

The Universal Tool complete. At all times it is set up for the various stages of a given caliber

the picture was taken "no charge," and now they are playing the game together. Handloading pulls men closer together.

In May 1937, Edwards sent through data on his latest homemade development—a bullet puller.

Designed for pulling .30-caliber bullets, this idea could readily be adapted to other calibers by the ambitious and mechanically inclined handloader. The head consists of a ¾-inch diameter piece of round cold-rolled steel, three or four inches long. A $\frac{5}{16}$-inch hole is drilled in the center lengthwise for two inches or so, ending at a ⅜-inch hole drilled through at right angles. The bar is then split lengthwise to the ⅜-inch hole.

To this a collar fitting the head is made from 1½-inch round steel bored with a ¾-inch hole in its center. The collar is about ¾ inch high.

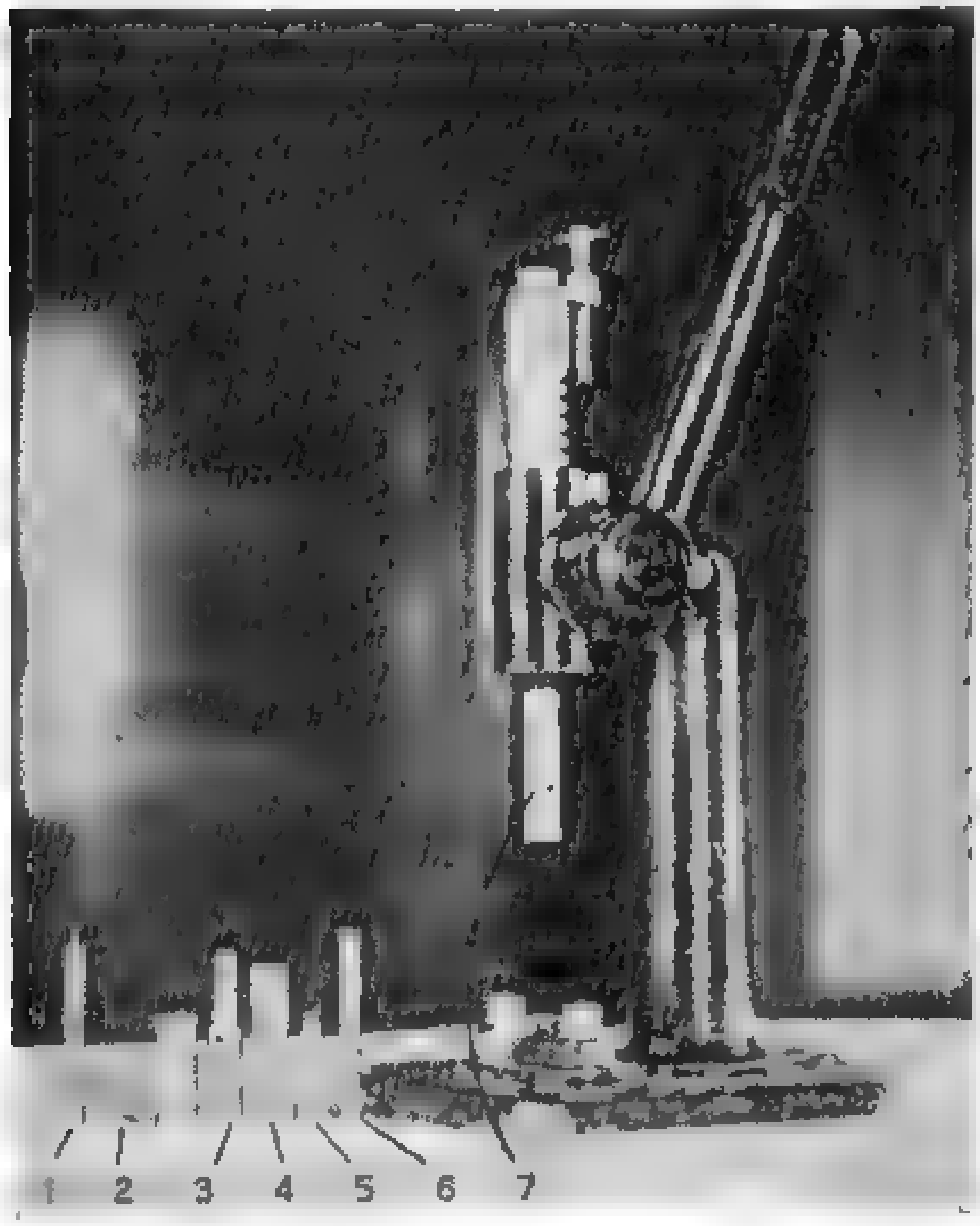
The Rotating Turret of the Universal Tool with Ideal powder measure properly mounted. One merely swings the rotating turret head from side to side to line up the various units for resizing and decapping, throwing powder charges, and bullet seating

A ⅜-inch cap screw with S.A.E. thread is used with the collar tapped to receive it. The rod section is drilled about ⅛ inch to receive the end of this cap screw but is not threaded. This serves to hold the collar in position. The handle was made from a 20-penny nail filed down to fit a $\frac{3}{16}$-inch hole through the hex head of the cap screw.

To hold the cartridge while pulling bullets, file a U-shaped slot in a piece of thin steel and fasten with screws to a table beneath the puller. The latter can be fastened to a wood lever attached to the wall or an upright by means of a strong hinge. Mr. Edwards suggests that it is not a bad idea to

fasten puller to a lever with a U-shaped bracket so the puller can swing sufficiently to let the cartridge head swing into the rim-holding notch.

"I have my puller fastened to my indispensable bottle capper," he writes, "and have a portable outfit which can be clamped to a table or stool and pull bullets in the kitchen on cold days rather than in my storage room. This set-screw and collar idea is the correct medicine for pulling tight bullets. I first tried the puller with thumbscrew



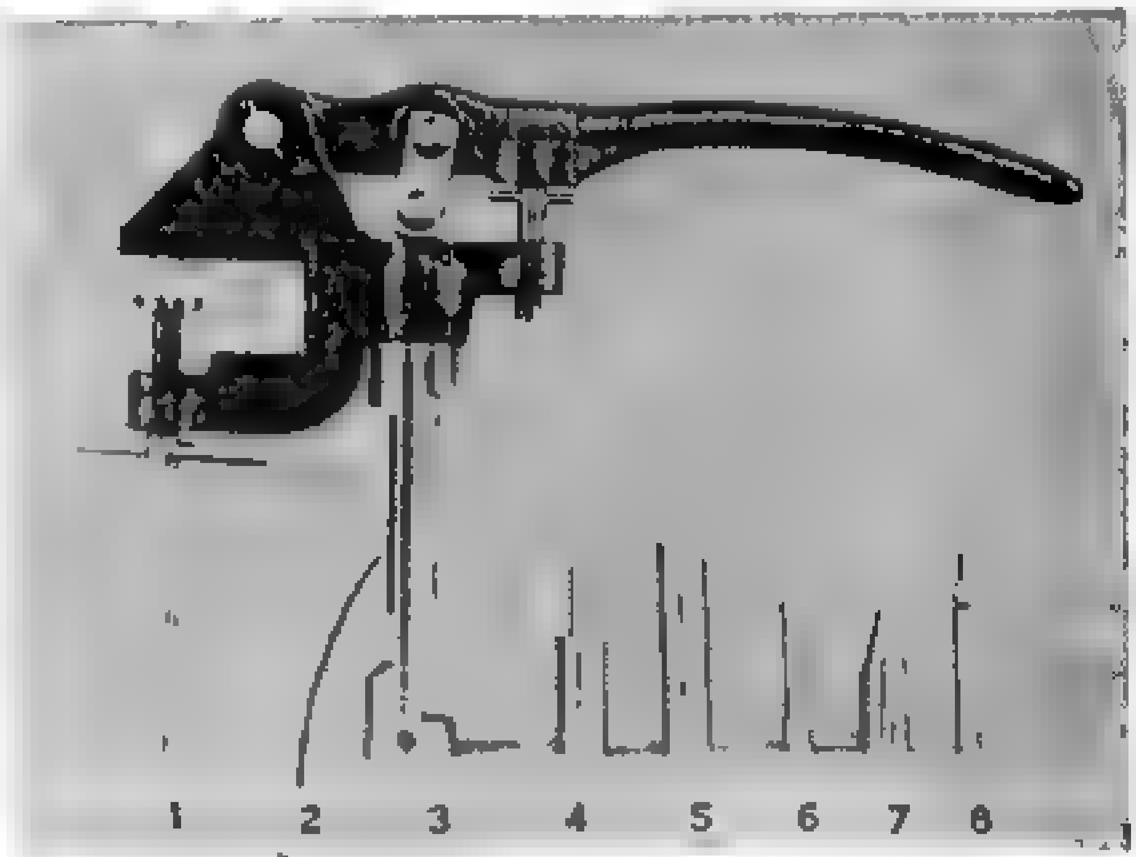
The Yankee Bench Loading Press, Model D. Various accessories are shown: (1) decapping punch, (2) shell holder, (3) muzzle expander, (4) muzzle resizer, (5) primer seater, (6) priming stake and (7) bullet seater

at right angles to the slot about ¾ inch from the bottom, but couldn't get enough tightening effect; the end holding the bullet wanted to spread rather than tighten. This collar and set-screw combination, as illustrated, puts the pressure where it should be.

For more than 50 years tools for the handloading of ammunition have been available to shooters. One of the pioneers in this movement was John M. Barlow, who founded the Ideal Manufacturing Company. Barlow was a shooter. He knew the shooter's problems and the Ideal tools of his design have been manufactured continuously since their origin. Millions of them have been sold throughout the world, and it is doubtful if there was ever a cartridge manufactured in this country that cannot be reloaded with Ideal tools.

Ideal tools are of two distinct types—the tong type for ordinary home loading, and the bench or semi-machine type, for quantity production by clubs, police departments and similar organizations. This latter type became known as the "Armory" type, because it was designed for National Guard units, who loaded their practice ammunition at their own expense. It was originally designed for the .30/40 Krag cartridge.

There was a time when all makers of arms recommended handloading, and this also applies to makers of ammunition. Components were listed in catalogs with all details necessary to the



The Yankee tong type of tool. This is not actually a hand tool, but the Model "C" is designed to be clamped to the side of the bench. It is available in any standard caliber. Various accessories in the illustrations are: (1) loaded shell, (2) bullet seater, (3) shell holder, (4) muzzle expander, (5) muzzle resizer, (6) priming stake, (7) primer seater, (8) decapping punch

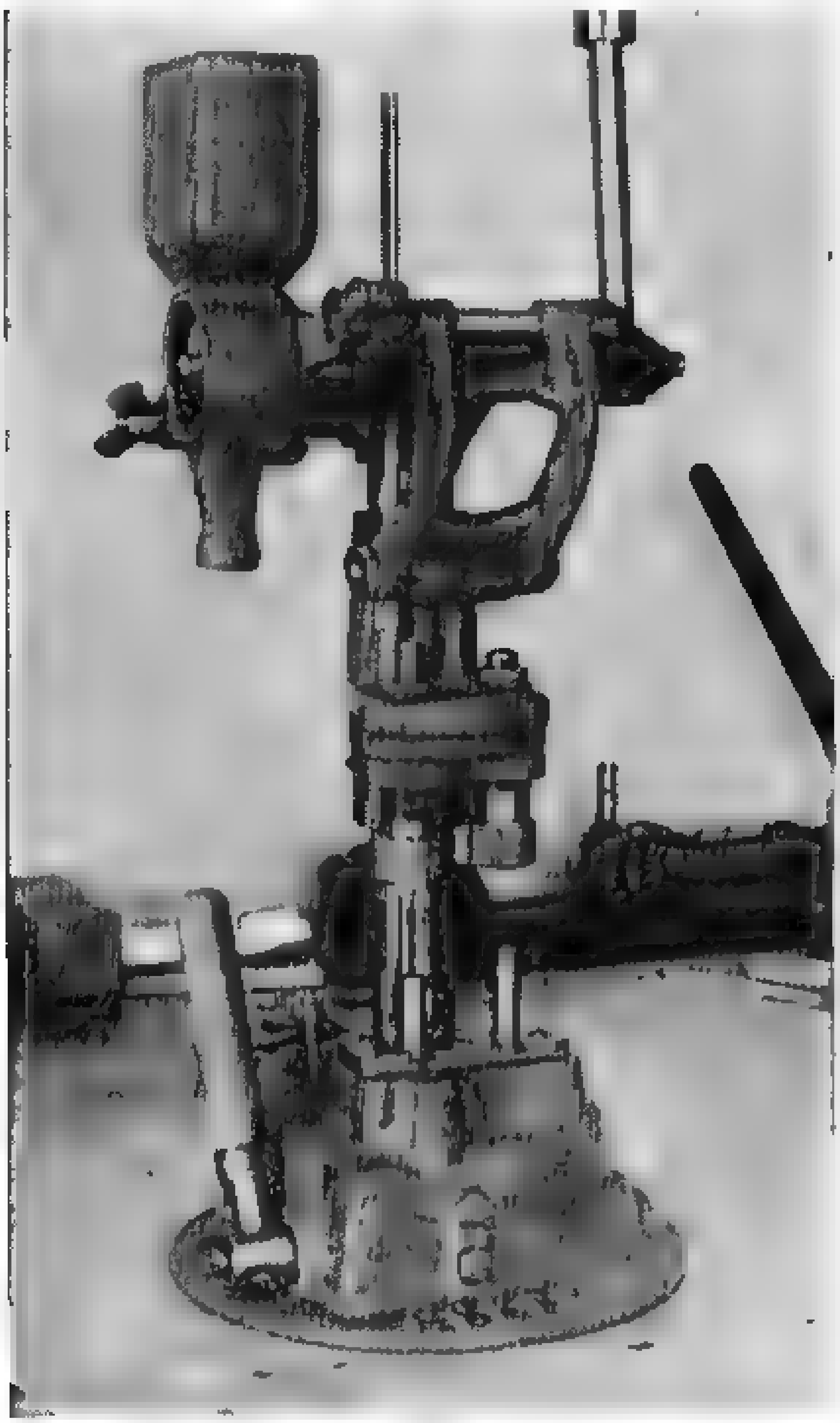
handloader. Winchester had their own line of loading tools. Smith & Wesson the same. Other firms likewise.

The Winchester loading tool and the Smith & Wesson type were very similar to the Ideal. Winchester tools were made in all calibers to which Winchester rifles were adapted. Smith & Wesson made tools for their own line of cartridges. These tools all sold for approximately the same price.

A 1907 price list is exceedingly interesting. The Winchester handloading tool did not contain a bullet mould on the end, as did some of the Ideal numbers. The bullet mould was, as it should be, an entirely separate unit. The tool in all small calibers, up to and including the .44/40, sold for \$1.50. The bullet mould was \$1.10, charge cups were ten cents each; the complete set of tools,

bullet mould and charge cup was sold as a unit for $2.50.

A different type, and somewhat better in construction, was known as the 1894 tool and was designed for the large military and sporting sizes, running from .25/35 Winchester up to .50/110 Express. This tool complete, with a separate bullet mould, charge cup, etc., sold for $3.00, and if the bullet mould was desired for hollow-point types, an additional 50 cents was added to the above price. Full-length shell-reducing dies, as made by Winchester in 1907, cost $2.00 each, any caliber.



The new Potter Complete Loading Tool. The powder measure is mounted at the top of the machine and is optional with the purchaser. Sizing head holds both bullet seating die and resizing-decapping unit. Operating lever with powerful toggle forces large sliding head containing dies down over shell. Auxiliary lever on the left side of the machine shows the primer seating device. Primer magazine may be seen sticking up between operating handle and powder magazine. Capacity 100 primers

Winchester in that year sold paper patches in any size at 50 cents a thousand, and patch paper at 55 cents a quire. Bullet lubricant was listed at the extremely low price of 50 cents a pound, and if wanted in sticks for use in lubricating machines, the price was 15 cents. The Smith & Wesson loading tools, as late as 1918, sold at $2.00 per set complete.

The Ideal tools of today are essentially of two distinct types—adjustable and non-adjustable. The loader who is purchasing a new tool should never choose the non-adjustable type, as he is very definitely limited to the use of a single bullet. By all means choose the more modern types with adjustable chambers, thus permitting the use of bullet seaters to fit any type of bullet.

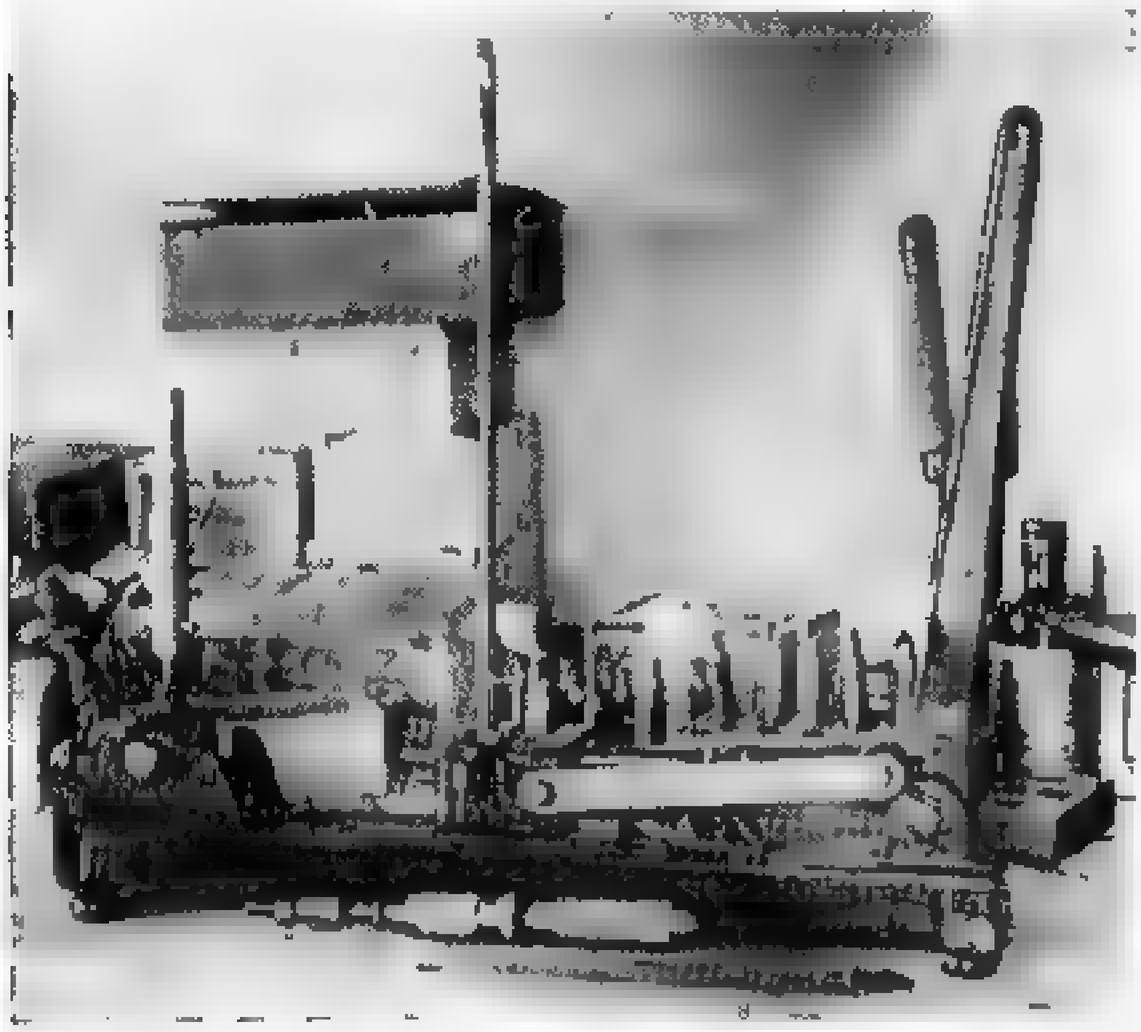
This tong type of tool, often called the "nut cracker," is by no means as simple to use as many experts would lead a beginner to believe. It requires extreme care, and as a result the tong type has come in for much undue criticism, so that the general trend has been toward the use of the so-called "straight-line" instruments for loading. Strange as it may seem, the majority of these straight-line tools *no more resize, reprime, and seat bullets in a straight line than the tong types;* drawings, recommendations, and other ballyhoo to the contrary notwithstanding!

Commercial loading tools are built slightly oversize; were it not so, Bill Jones of Oshkosh, who desires to reload his particular cartridge cases without full-length sizing, since his gun has an oversize chamber, would find to his great sorrow that it would be necessary to resize his shells to get them into the chamber of the loading tool. Accordingly these parts are cut slightly large to take care of the great variation and tolerances permitted in the commercial manufacture of arms. This same oversize tool, if used by the chap who has a tight chamber, will show a considerable amount of play, thus killing any "straight-line" effect through a tipping of the case during the various operations.

Regardless of this manufacturing fit, precision results can be obtained with tong-type tools. By the same token, some very poor concoctions will be assembled by the careless operator who believes that the tool he bought for a "straight-line" is actually capable of doing his thinking for him. The Ideal user, therefore, should not consider himself handicapped because of "poor" equipment. He should study his tool very carefully, learn its limitations, and solve the problem in his own way If

he is more interested in precision than in speed, he will be able to produce good handloads.

There are numerous loading tools available. Hardly a year goes by without seeing additional equipment for the handloader. The year 1935, for instance, produced to the author's knowledge three new powder measures, an automatic priming attachment for an old-established bench tool, the addition of a new type of bench tool by one of our old and well-known firms, and the initial production of five others by as many different makers now placing them on the market. The handloader should learn early in the game that he can spend much or little on his equipment, and if he uses a normal amount of intelligence in the assembling of his loads, he can produce results equal to—or better than—standard commercial ammunition with almost any form of tool.



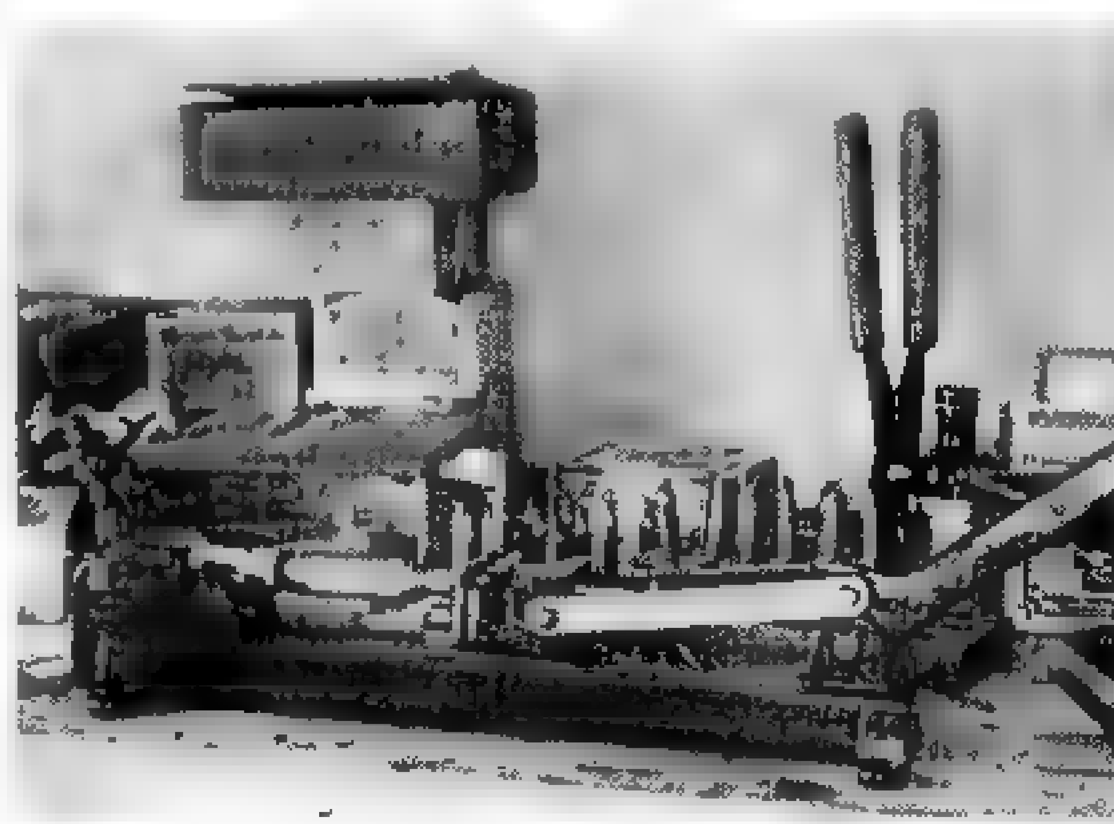
The Schmitt Tool with shell resizing die in upright position on rest. This is hinged down to meet the sliding center portion. Bullet seating die is shown in front of the tool

Without question, the modern straight-line bench loading tools are superior to the ancient and early tong types. They do, however, cost more money. The beginner will do well, if he is at all interested in the financial standing of his reloading equipment, to confine his initial expenditures to low-priced tools. As he acquires experience, his ideas will develop.

I have a prominent handloader friend who used to insist that to turn out ammunition developing the uniform precision of factory loads, it was necessary to have a complete set-up of straight-line bench tools, balances and other equipment. He declared that no one using a low-priced tong tool could equal the factory product. This particular handloader used a bench tool with dies and accessories valued at more than $100.00. His balance was a sensitive affair worth as much. He had other equipment for handloading which must undoubtedly have run the cost up an additional $100.00—and he thought he knew.

The author has spent a considerable amount of time *working* in the laboratories of Du Pont and Hercules, particularly in the developing of various handloads for this volume. He has used their equipment quite extensively, and is somewhat familiar with that in daily use at Du Pont Burnside Laboratories at Penns Grove, New Jersey, and the Hercules Experimental Station at Kenvil, New Jersey. Both of these stations have a *complete assortment* of Ideal tong types of tools. They use these for the majority of their experimental work, and what is more, *they have used these same tools for more than a quarter of a century!* After use, the tools are stored in large racks or drawers, according to caliber, so that when wanted they can be secured with a minimum of delay.

The author has personally shot a great many factory loads in various calibers, running from the .22 rimfire cartridges up through to military rifle calibers, testing them for velocities and pressures. He knows approximately what may be expected from the commercial product in the form of variations or "working tolerances." He also knows what the employees of those laboratories can do with tong-type tools, using normal speed but extreme care. Tell Harry Lee of Burnside Laboratory that he couldn't take an Ideal tool and assemble a group of cartridges equal in uniformity of velocity, pressure and accuracy to its counterpart in commercial loadings, and you'd break his heart. Harry works for Du Pont Burnside Labo-



The Schmitt Tool with bullet seating die in position

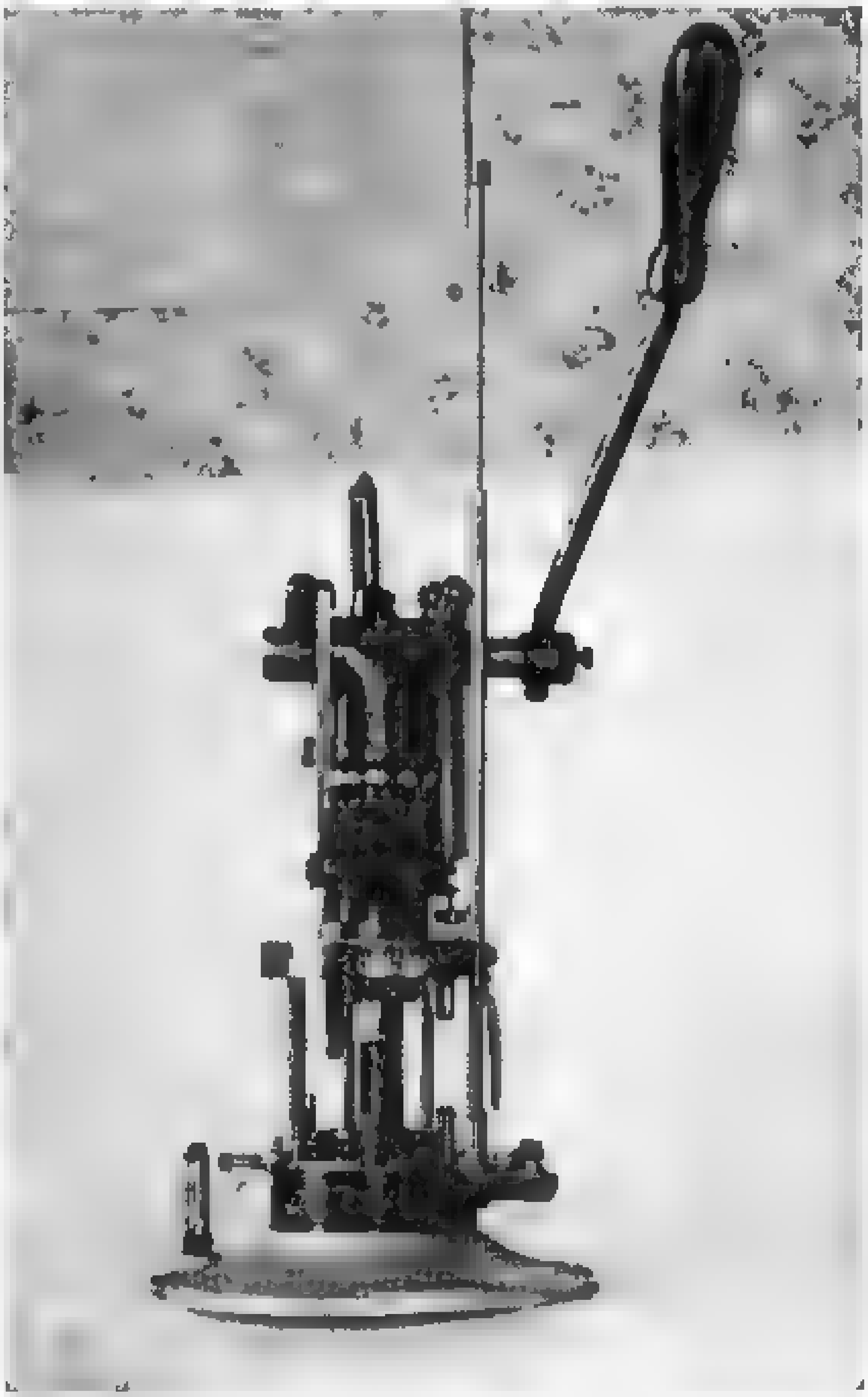
ratory—not the Ideal Manufacturing Company. He knows how to load; he has been loading for years. And he considers it perfectly normal to use *care* in assembling his cartridges.

The mail received by the author during the past few years containing questions on handloading, complains about the slowness of various tools on the market. If you insist on loading 10 cartridges per minute, the standard commercial loading tools are definitely and positively out. You must plan to spend money for your equipment, and you must definitely decide upon some of the expensive production jobs which cost not less than $60.00. The true handloading enthusiast does not demand speed, he demands precision, and any tool on the market today will deliver this result if properly handled.

Star Loading Machine. This machine delivers a completely loaded shell at each cycle of operation

HAND TOOLS

Ideal Tong Type. This tool is available in four distinct forms: The non-adjustable type with bullet mould attached, the non-adjustable type without bullet mould, the adjustable type with bullet mould, and the adjustable without the mould. If you intend to purchase a new tool, by all means get the adjustable type—for reasons previously mentioned—and have your mould an entirely separate unit. These various types are fully described in the Ideal Handbook, available from the Lyman Gun Sight Corporation, Middlefield, Connecticut, price 50 cents. Accordingly, this book will not endeavor to repeat the manufacturer's statements concerning his own product—information readily available elsewhere.



The most expensive model of Star Loading Machine. This is superior to all other loading machines in its speed and uniformity of operation. One merely feeds shells into the rotating turntable and bullets into the bullet-seating station, operating the lever each time. The fully loaded cartridge is automatically discharged through a discharge slot at each operation of the handle

The Ideal Handbook, incidentally, should be in the possession of every reloader, whether he uses Ideal equipment or not. It not only contains in-

formation concerning Ideal tools, but also lists all bullets manufactured by that firm, giving complete specifications of each bullet, including practically every obsolete number for which that firm produced moulds in past years. It is often quite possible to develop interesting loads with "obsolete" bullets, if they happen to fit the barrel of a modern arm.

Another useful number which every reloader should acquire is the Belding & Mull Handbook, selling at 25 cents. It is available from Belding & Mull, Inc., Philipsburg, Pennsylvania. This handbook also gives complete instructions for individual use of the various Belding & Mull tools. It contains much other practical data of interest to every handloader.

These two handbooks—the Ideal, the Belding & Mull—are released annually, and it is wise for handloaders to acquire each new issue as it comes from the presses. Certain changes, additions and improvements are usually made to bring these handbooks up to date in every respect. Many thousands of them are sold each year, and the author assumes that readers of this volume will have both handbooks available for reference purposes.

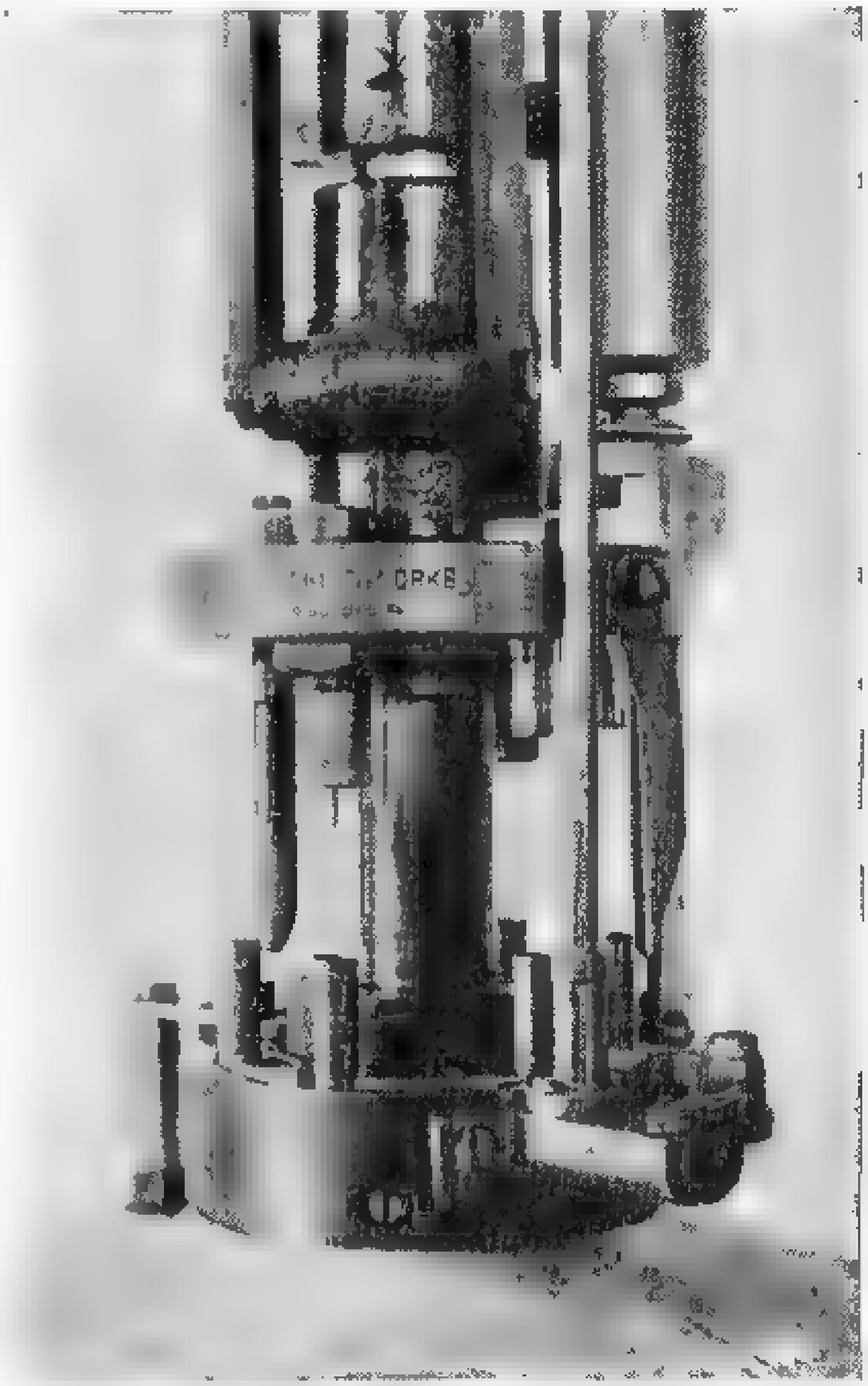
Current prices on Ideal tools are uniformly the same as in recent years past. The $4 tool, equipped with bullet mould and non-adjustable chamber, sells for $8.00. The $6, with double adjustable chamber and bullet mould attached, is $10.50. The $3 double adjustable chamber model, no bullet mould, and the $10 ditto, each lists for $6.50. The $10 is essentially the same as the $3, except that it is adapted for rimless types of cartridges.

Bond Tong Type. Although this tool is no longer manufactured, it is frequently encountered in the used market by handloaders. This tool was the first practical "improvement" on the Ideal and is known as the Bond Model "B." It is essentially the same as the Ideal, but has a large set of heavy cast-bronze handles. The various accessories are made of cold rolled steel.

This outfit is quite a bit heavier than the Ideal, but in the author's experience was not in the slightest better. I had one many years ago and was none too well pleased with its performance. Although the dies showed sloppy workmanship, one could, with reasonable care in handling, assemble some very accurate loads. The handles had sharp edges, making it advisable to file them.

Although this tool is no longer manufactured, the various parts can be obtained from its makers, the Modern-Bond Corporation, Wilmington, Delaware. Thus any handloader having one of these available can readily obtain dies in different calibers to fit these handles.

Yankee Tong Type. The Yankee tool of tong-type construction, known as the Yankee Model "C," is more of a bench-type outfit than a hand tool. It can be used in the hand, but is fitted with

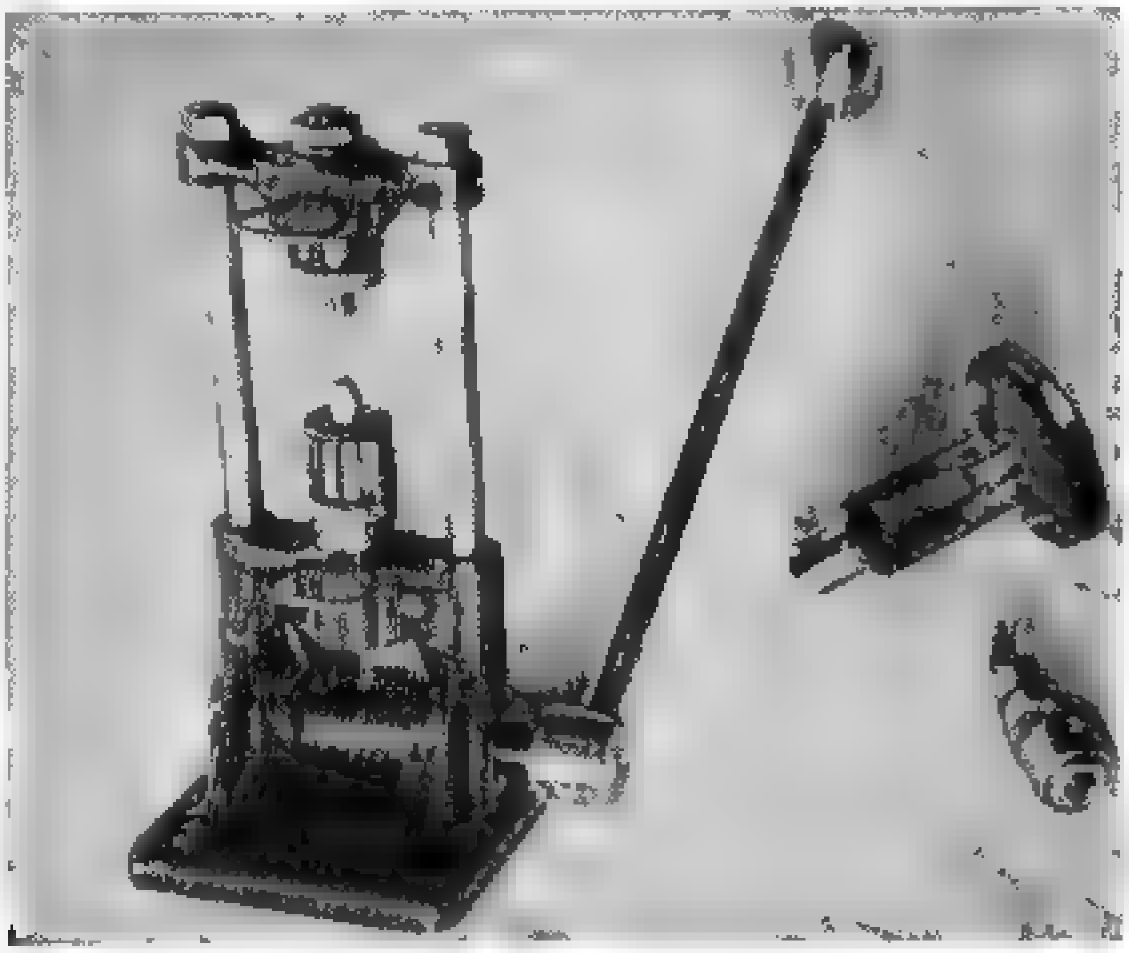


Close-up of the Star Loading Machine. Note rotating turntable with shells in position, automatic primer feed, and automatic powder measure

a clamp to enable it to be attached to the loading bench. The author has never personally handled this tool, but knows several persons who have had excellent results with it. One reader friend wrote me that he had one of these tools, together with a great many attachments for different calibers, and that the workmanship in all parts was far superior to the general run of these items. He stated that recently, with the development of a new type of cartridge for which he desired to handload, he sought the necessary parts for his Yankee, submitting a fired shell and dummy cartridge to the makers to be used as samples. He requested

immediate action and was surprised to receive the necessary parts made to his order and shipped to him within two days by first-class mail.

The Yankee tool, formerly manufactured by the Yankee Specialty Company, is now built by W. Rohrbacher, 513 Sanford Place, Erie, Pennsylvania. He does not carry it in stock and wrote me at one time that each tool was built to the individual order of a customer "and thus was built right." His Model "C" tool sells at $7.00 complete in any one caliber.



The new Bond Model "D" Loading Press, the best-designed press ever turned out of the Bond factory. It is quickly changed over for different stages of operation. Press as shown above is set up for bullet seating for the .38 Special, and delivers excellent work. Dies do not screw into the holders but slip in and are locked by means of the large horseshoe springs visible in the top and bottom center of the picture

BENCH-TYPE TOOLS

Generally speaking, the bench-type tool is more sturdy in construction and in operation than the tong or hand type. Usually it is somewhat faster to operate, and with reasonable care and skill one is likely to get great precision in loading. Some of these tools, however, show very poor workmanship in certain parts, and the handloader, in purchasing new equipment, should immediately put it to use and register a complaint with the manufacturer if he finds anything to be unsatisfactory. The primary reason for the superior accuracy of the bench type of tools is that the instrument is held more solidly, thus giving the reloader both hands with which to perform the various functions. Thus, reasonable speed is obtained in assembling various loads.

Yankee Model "D." This tool is built, of course, by the makers of the Yankee tong type. It is sturdy and excellent in design and its equipment is precision built, according to friends who have these instruments. Reloading is in the vertical straight-line principle, and the various dies are interchangeable with those used in the Model "C." This bench-type tool weighs 16 pounds, and complete, with accessories, costs only $15.00. Additional dies may be added as the reloader increases his equipment.

Bond Model "C." This is a bench-type tool, and while capable of excellent work is slow in performance, due to inferior design. In many ways it is impracticable, but in the hands of an intelligent and careful operator, good results can be obtained. It is necessary to set the tool up with the decapping shank in position and the decapping and priming bushing set into the head of the tool. The empty cartridge case is dropped over this decapping outfit, pushed into position, and the operating lever lifted, thus pressing out the old primer.

The second operation consists of reversing the decapping and priming bushing and screwing it into the tool head, opposite side up. The decapping pin is removed from the shank, and the pin-clamp nut is replaced, the empty case dropped into position, the primer pressed over the pocket with the fingers, the case pushed under the priming head, and the lever lifted to seat the primer.

The third operation consists of stripping down the decapping shank and dies and setting up an additional shell holder and shell-sizing die to reduce the neck or body of the cartridge case. The expanding of the inside of the shell, also a very necessary operation, requires a still further tearing down of dies and insertion of expander. After the powder is run into the cases, the set-up must be torn down for the fifth time and replaced with the loading chamber of the adjustable type containing the proper bullet seater.

Criticisms and Suggestions: The decapping and recapping operations are closely related—the relation being much too close in this particular type of tool. The operator must watch carefully to see that the decapping pin is clamped solidly in position by its particular clamping nut. Should this work loose, the pin will very definitely bend, thus mutilating a shell and tying up all decapping operations until the bent member is removed and replaced.

The principle of removing this pin for *recapping* is wrong. It encourages the handloader to set the clamp nut with his fingers, whereas in any well-regulated tool, this should be set up solidly with

pliers to prevent its working loose and thus becoming bent. Furthermore, the head of this decapping rod, minus its pin, supports the cartridge case from the inside during the priming operation. Should any burrs be raised on a cartridge case around the inside of the flash hole during the perforating process in manufacture (see Chapter III), these burrs will be turned over during the priming operation, thus closing or partially closing the flash hole.

Furthermore, when the tool is used with the semi-balloon type of cases (in which the primer pocket projects into the interior of the cartridge case), careless handling is inclined to crush this pocket slightly, thus preventing the primer from seating properly and ruining the shell. In performing various operations with this model of tool, the reloader should resize, decap, reprime and conduct the various operations with as many shells as possible, thus eliminating as much of the teardown as he can. The tool is effective, but is probably the slowest of all forms in operation.

Belding & Mull Model #26. The Model #26 is of the straight-line bench type, operating horizontally instead of vertically as do the Yankee, Ideal, Bond, Frankford Arsenal and Pacific. Interchangeable dies for this tool readily adapt it to other calibers. The instrument is manufactured by Belding & Mull, Philipsburg, Pennsylvania, and sells complete for $7.50. This tool does not seat bullets.

Where the Model #26 tool is used, the separate unit, known as the Model #26 die-and-plunger-type straight-line seating tool, must be used to complete the handloading operation. This latter tool is an excellent accessory. It sells on the current market for $2.50. Although slow in operation, this Model #26 is much faster than the Model "C" Bond and is equal in speed to the Ideal tong type.

Belding & Mull Model #28. This Model #28 tool is essentially an improvement on the Model #26, and dispenses with the auxiliary hand bullet seater. In shifting dies because of a unique arrangement of lock nuts, the annoying but necessary operations are quickly accomplished, so that the resetting of the tool for additional loading steps is a matter of a minute or two. This tool is particularly useful to the man who desires to reload in small quantities While it is fitted with bullet-seating dies, it has one weak point, in that it is not adapted to cartridges requiring crimped-in bullets, such as the revolver species. Accordingly, the makers suggest that it be used with a Model #26 hand seater for the latter work. This Model #28 tool complete costs $14.00.

Schmitt Model #12. The Schmitt reloading tool is a beautifully engineered and finely constructed development designed and manufactured by C. V. Schmitt of Minneapolis, Minnesota. The author first met Mr. Schmitt back in 1927 at the National Matches at Camp Perry, where he had samples of his tools on display at the Minnesota National Guard tent. Schmitt is a metal-working artist and

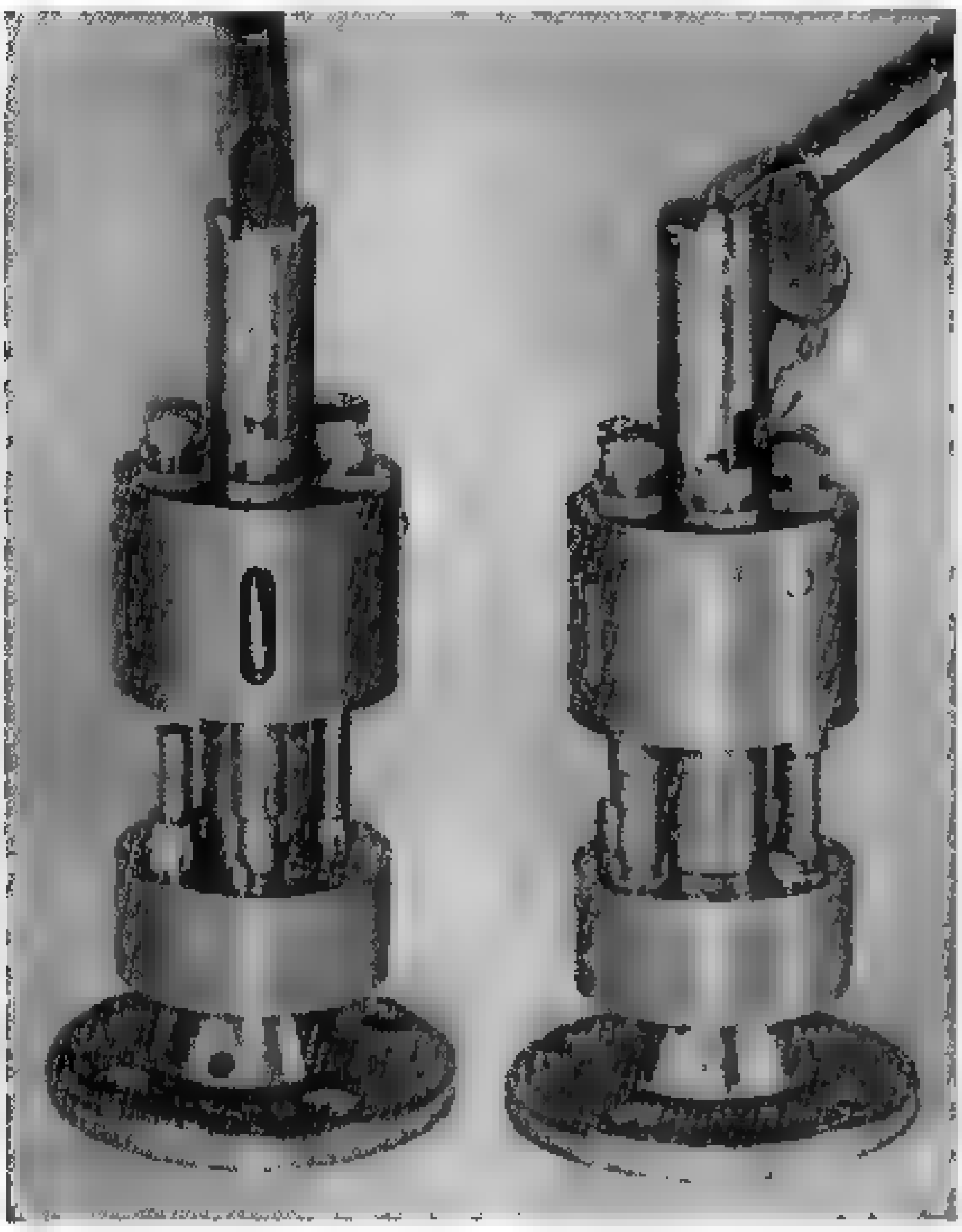
The old Bond Loading Tool. Capable of good work, but extremely slow in operation

an expert loading-tool manufacturer, but he is one of the poorest correspondents we have ever had the pleasure of knowing. Friends who have purchased loading tools have occasionally been compelled to write many times before their tool was received, and others inquiring had their communications completely ignored.

There has never been a complaint reaching the author on the quality of the Schmitt tools, and it would seem that the sole trouble lies in the fact that Mr. Schmitt has an active production and no office staff, and cannot spare the time necessary for answering letters. When he gets an order he fills it as soon as he can, and that's that!

The Model #12 Schmitt tool is manufactured as

nicely as any loading tool ever offered to the commercial trade. It is an adjustable affair, and additional dies will change it from one caliber to another. One of the features of this tool is that the recapping pin can be adjusted to seat primers to any desired depth. Thus it is necessary to use only normal care in the seating operation, as once ad-



A 1935 development: The Jordan Loading Tool. This tool is completely set up at all times and may be kept continuously set up for two complete calibers. Illustrations show the tool set up for .38 Special and .30/06. Left: Bullet seating station is exposed in this picture. Right: Side view of the Jordan Tool. This tool may be rotated and clamped in any position desired to expose the proper dies. Note priming station in the center. Primers inserted in cavity of spring-retracted shell holder in center of lower table

justed for a particular size and make of case, all reprimings will have a uniform depth of primer.

The tool is as much of a straight-line as anything on the market, and with two movements of the lever—one forward and one back—all small cases such as pistol and small rifle are full-length resized, decapped and recapped, the neck expanded, the crimp removed, or in small bottle-necks the inside of the case-neck expanded, and the new primer inserted.

All of these operations can be controlled and adjusted in the die to suit reloaders' particular requirements. This tool, however, will not full-length resize large cases like the .30/06 and .30/40, and in these calibers it comes equipped only with neck-resizing dies. The automatic primer feed is truly automatic. The tube is filled by means of a special tray accompanying the instrument and holds 125 of any size. This primer-feed tube is designed on the yielding principle to prevent breakage in case of a jam. Its maker claims that large and small primers can be used in it without changing slides or tubes.

Changing the various dies for the different operations is by all means the fastest in any tool ever assembled. Mr. Schmitt claims that the dies can be removed and replaced with others in ten seconds, and without disturbing adjustments of either die. After handling the tool I fully agree with him. His Model #12 has sufficient weight to insure ease of operation and great life. It is 14 inches long and weighs about 12 pounds. Various accessories can be obtained for bullet pulling, bullet lubricating and sizing, and a number of other auxiliary operations.

Mr. Schmitt has always requested that customers send samples of empty shells fired in the customer's gun with full-charge loads. He also likes to design his seating plugs and fit them to the customer's bullet samples. The various dies have a certain floating motion which, although minor, is designed into the tool to permit the case to properly align itself with the die.

Few tools are more simple to manipulate than the Model #12 Schmitt. During a long talk with "Connie" Schmitt at Camp Perry in 1935, I criticized—in theory only—a few of the design features of his tool, and received the best answer in the world—a demonstration. I was so impressed that I was among the several dozen handloaders to take a set back from Perry, and for two years I have used it, loading my own .30/06 loads and many hundreds for friends.

Despite the fact that the tool looks complicated, it is simple to operate. All parts, working in a vertical plane, are easy to handle, and the various steps are as speedy as in any other form of bench tool, with faster feed than most of them. When you are through shell-resizing and priming—all done with a single sidewise motion of the lever and return—you unscrew a single bolt with the fingers, withdraw it, lift out the resizing die, drop the bullet-seating rest bar into a slot in the frame, and you are tooled up to seat bullets. It is not even necessary to remove the primer magazine with its contents, although this would be advisable.

This horizontal bullet-seating problem had me worried about the spillage of powder. Nothing

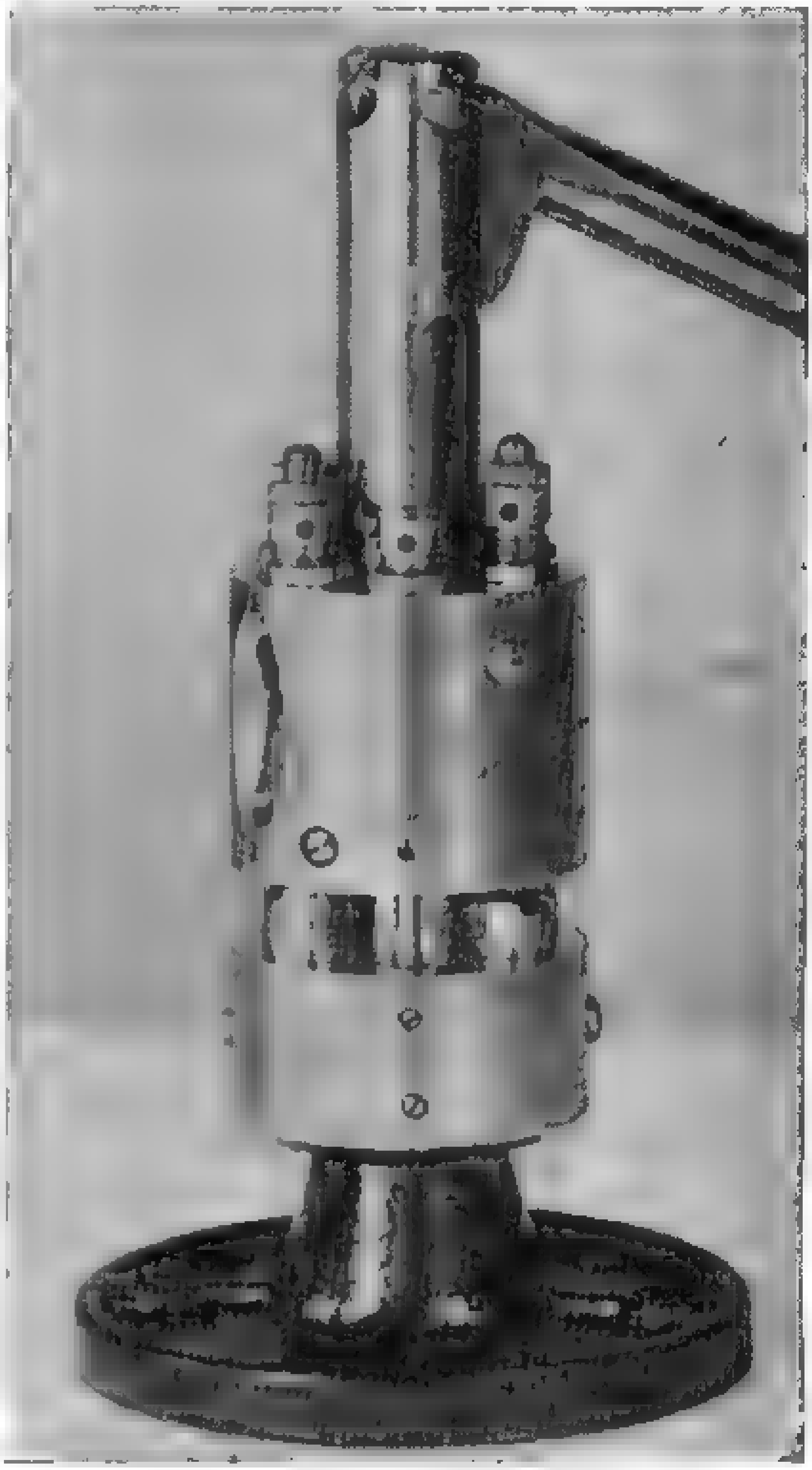
to it. I've reloaded several thousand rounds and have never spilled a kernel, using all kinds of loads in the .30/06. The secret is to lift the seating die from its guide with the left hand, and slip it over the filled shell and bullet held with the right. Some bullets can be dropped into the die and will remain while you gently insert the shell. It is extremely fast. Then lay the entire unit in its guide, slip the shell head into its proper support, and work the handle. Takes less time than to read the above. Detailed description of the Schmitt will be omitted since attempts to contact Mr. Schmitt in post-war years have failed to bring a reply, and it is not known that he is still in business. Others have made similar attempts without success.

The Pacific. This is one of the most practical all-round tools ever produced, and the author has used one for many years in numerous calibers. At the time he obtained his Pacific many years ago, he believed it to be the best on the market, and the addition of numerous dies and accessories in various calibers was merely the product of expansion in an effort to reload for different guns. He has noticed with keen interest that the Pacific people have greatly improved the quality of their accessories in recent years to keep up with the parade. Dies adapting this tool to different calibers purchased within the past year show much finer workmanship and minimum tolerance.

The Pacific is manufactured by the Pacific Gun Sight Company, 353 Hayes Street, San Francisco, California, and in its present form it is practically identical with the original Pacific except in quality of material and workmanship. This tool is essentially a heavy cast malleable-iron base designed for bench use. It cannot be used in the hands. It operates in a nearly vertical plane. The tool is shaped like a horseshoe with an extension of one prong to hold the operating lever. The various dies and attachments are screwed into the upper arm of the horseshoe during the period of their use. It is thus unnecessary to spill any part of the powder charge, and with many other tools this is one of the primary criticisms.

The shell holder of the Pacific is of the rising type, and its decapping and resizing die is screwed into the upper arm in proper position. The fired shell is slipped into the shell holder, the operating lever raised, thus forcing the cartridge case into the decapping and resizing die. The operation forces out the fired primer, full length or neck resizes the cartridge case according to the dies being used, and in the case of revolver cartridges removes the crimp and slightly bells the muzzle—all in one operation.

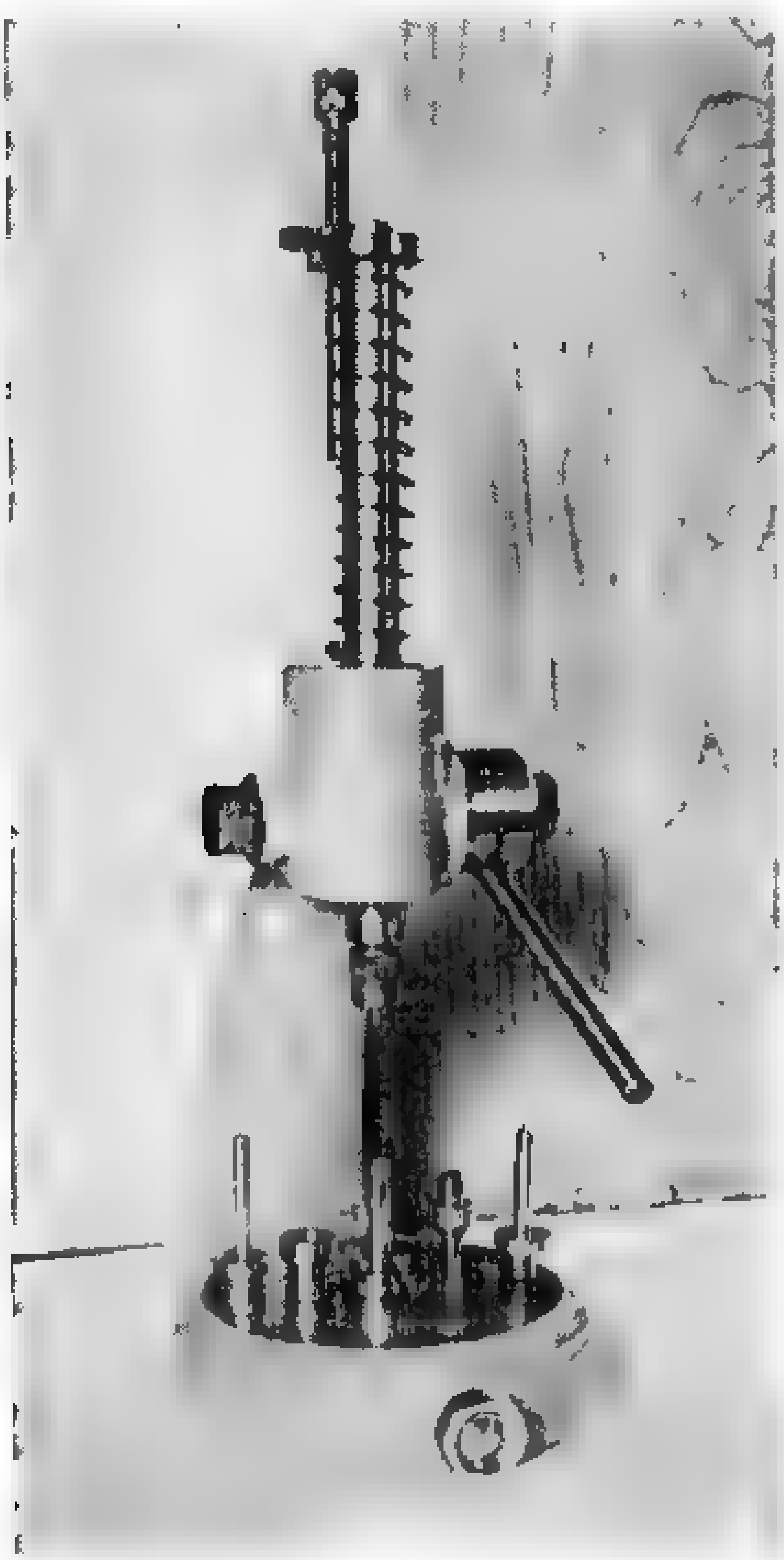
A primer arm extending from the forward side of the instrument has a small cup surrounding the primer seating punch. The primer is dropped into this cup, face down, and the primer holder pressed forward into a groove milled into the side of the



New Jordan Tool released in May 1937. This has latest micrometer adjustment on dies

shell holder, holding it lightly in position with the thumb. The operating lever is then pressed downward, extracting the cartridge case from the die. By means of a suitable expander plug which enters the unfired case before resizing, this is drawn through the neck of a rifle cartridge case, thus expanding it to the desired diameter. Continued downward pressure of the operating handle then forces the primer into its pocket, whereupon the lever is lifted slightly, causing the priming arm to

fly forward out of the way, propelled by a spring in its base. The lever is then pushed all the way downward and the prepared cartridge case is removed from the shell holder with the fingers.



Special homemade straight-line tool designed and manufactured by H. A. Donaldson, Little Falls, New York. This is a revised version of the old Perfection. The stock screw at the top center accurately controls this modernized "arbor press" type of tool. Various units such as the resizing dies, priming stakes, decappers and bullet seaters are securely held in position on the flat-base table by screwing into a properly aligned and threaded hole. Other units are screwed to the spring-retracted straight-line plunger operated by a rack and pinion gear

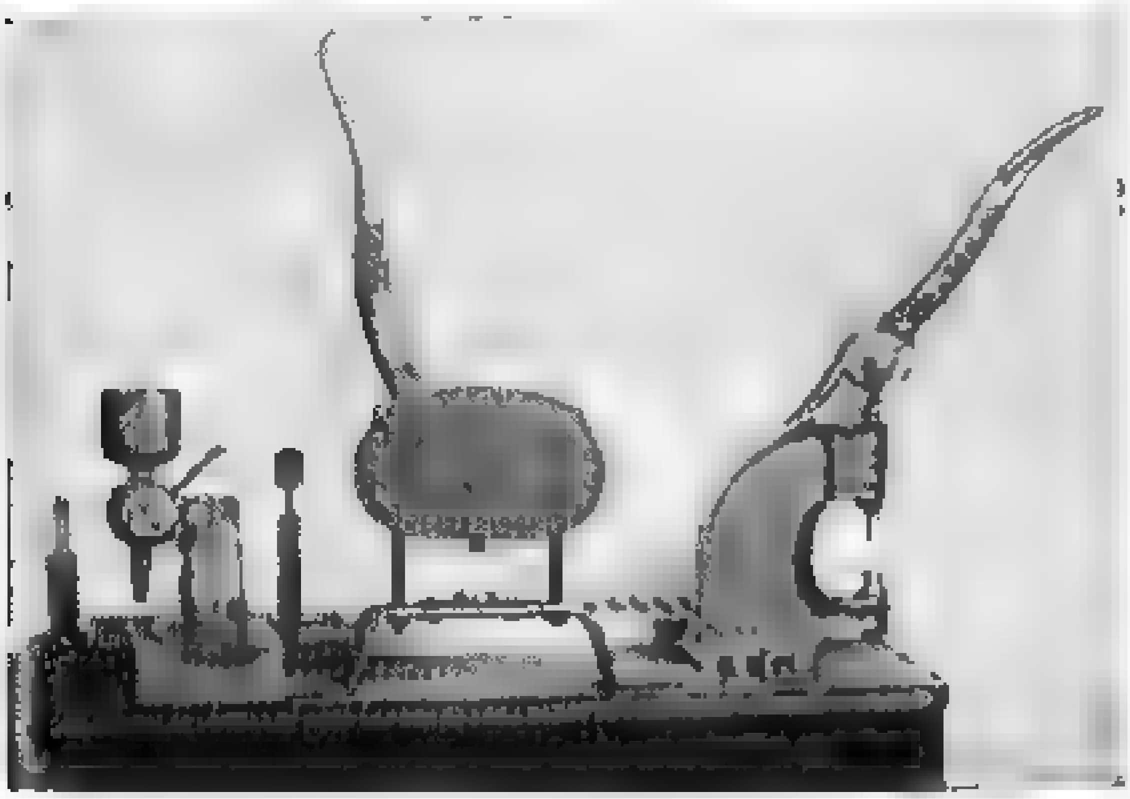
The author's notes indicate that in using this tool to completely prime and resize .38 Special shells, a normal speed was maintained and 100 were prepared in twenty minutes. This includes, of course, taking fired cases as they come from the gun and preparing them ready for the powder charge. Another test conducted at normal speed over a ten-minute interval shows that 46 shells were primed and resized during that time. Another test with this tool consisted of decapping, resizing and expanding only, using Peters .38 Special shells, and 123 were run through the tool in ten minutes—the rate of 738 per hour.

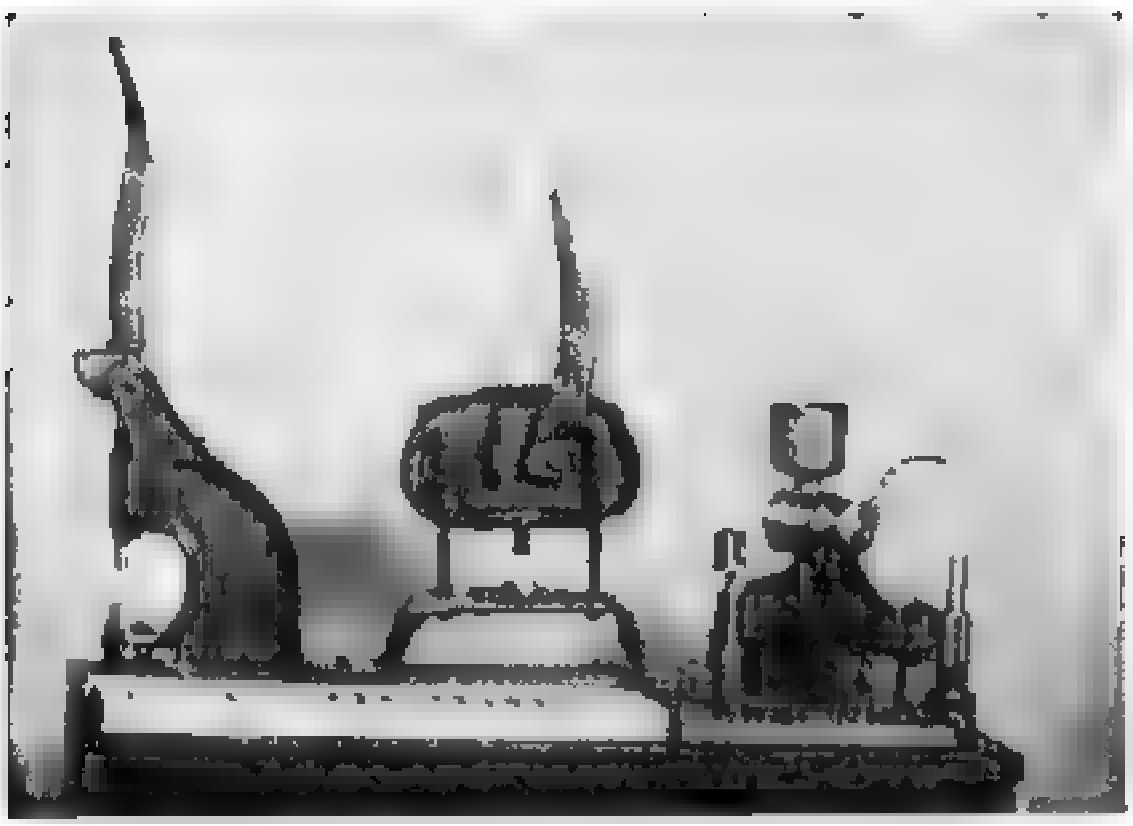
Early in 1935 Pacific brought out an automatic primer attachment which greatly simplifies the work of handling this tool. A careful operator in resizing his shells will find it convenient to wipe them with a slightly oily rag before running them into a resizing die. This serves two very definite purposes; *first,* it wipes all abrasive dirt from the outside of the case, and *second,* coats it very thinly with a lubricant. Both operations simplify the resizing of the shell by minimizing wear on the dies, at the same time greatly reducing the effort required to force the shell into the die.

Without the automatic primer attachment this necessary wiping and lubricating of fired cases creates a problem in that the operator must free his fingers of oil before picking up the primer. The author used an old rag which he attached to the side of the tool by tying it in position and permitting it to trail downward. This kept it handy, eliminating the necessity for picking it up and laying it down each time. The automatic primer arrangement, however, eliminates the necessity for the operator to touch his primers with the fingers, thus speeding up the handling to no small degree, and eliminating the possibility of oil leaking into and destroying the priming composition. If any handloader has an opportunity to purchase a loading tool which he is able to equip with an automatic primer feed he would do well to bear this point in mind.

This Pacific automatic attachment is extremely simple in both design and operation. A special cast-bronze or aluminum support is clamped to the top of the tool body by means of self-contained screws. Into this a loaded tube of primers is inserted. A spring stop built into the bottom prevents spillage of the primers. The normal priming arm is operated in the customary manner, except that when being pushed to the rear by its own spring it falls into a socket of the automatic primer attachment, pushing aside the stop spring and permitting a primer to drop from the tube into its cup. When it is pushed forward to prime a shell, the stop spring again gets into action to prevent primers from dropping out. The design is such that should that primer not be needed and the arm permitted to spring back into its charging position there will be no double feeding of primers. It is comparatively fool-proof.

Two sizes of tubes and priming arms are used with this tool, to hold the standard small rifle and handgun primer, diameter .175, and the other large rifle size (used also in many handgun cartridges), having a diameter of .210. Charging these primer tubes is extremely simple. Each tube is its own loading tool. At the bottom is a perforation for



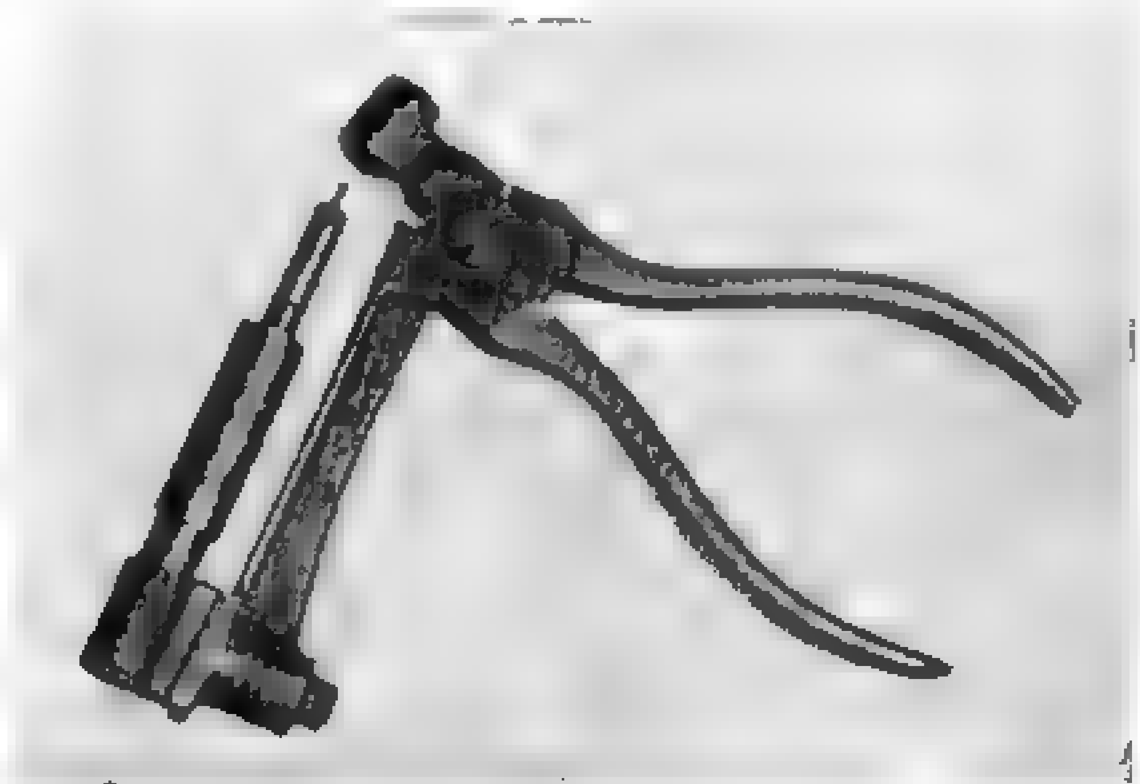


Another series of homemade loading tools assembled by C. R. Edwards, of Chester, South Carolina. Powder measures are described elsewhere in this book. The hopper is a large brass grease cup from a steam engine. The bullet sizer shown in the center was cut from an old plug-tobacco cutter. The shell resizer and primer seater shown on the right was manufactured from an old brake-riveting tool picked up from junk in a garage. Lower: Back view of the same instruments. Note in particular bullet resizing die made from the tobacco cutter. This is designed to resize bullets for the .45 ACP revolver and automatic pistol. The resizing die proper is an old generator bearing from a Ford car which happens to be of proper size for this bullet

the insertion of a cotter pin. The operator merely pours out loose primers into a dish or empty primer-box cover, and shakes them lightly, whereupon a large number of them turn right side up. The top end of the tube is slotted and is pressed over each of these primers, thus forcing it into the tube body. The slotting also serves to form a spring to prevent spillage of primers.

All upright primers are picked up in turn by merely pressing this slotted end over each one, whereupon the container is shaken slightly again to produce another group of "right side up" primers. The process is continued until the tube is charged with 50 primers. A number of tubes can be kept on hand properly charged, and when one is empty it is merely necessary to lift it from its socket, insert the charged one, and after it has dropped into position, pull out the cotter pin, thus permitting the primers to drop into the primer-seating punch pocket.

A recent test of this automatic primer attachment was made on 300 Winchester .44 Special



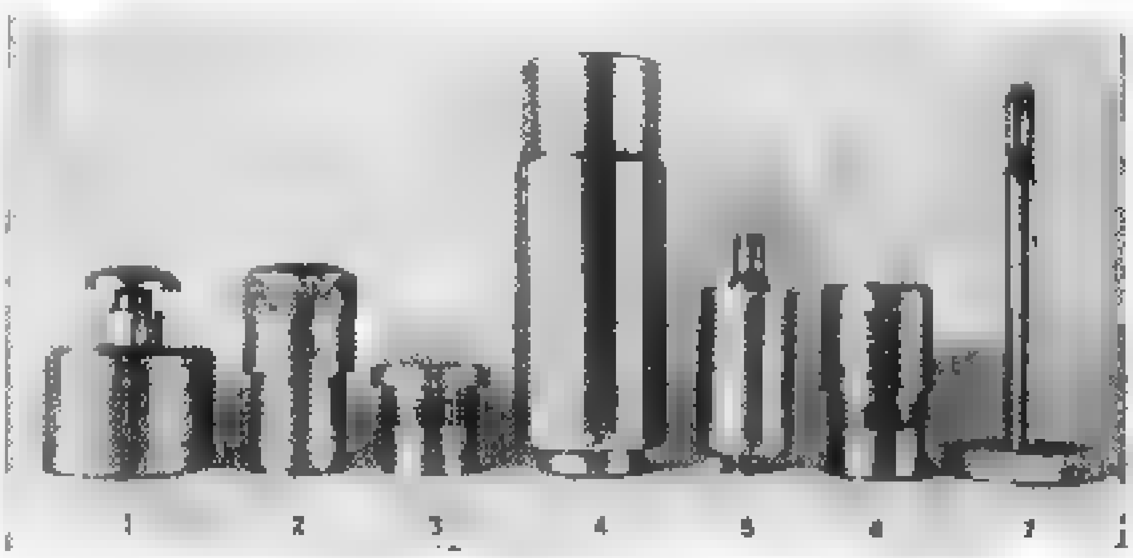
An extremely useful accessory sold some years ago by the Director of Civilian Marksmanship—the old Frankford Arsenal Decapping Tool designed for the .30/06 and .45 caliber automatic cartridges. Very simple to handle

shells with Winchester #111 primers. The wiping, priming and resizing was done in groups of 50 The longest time for 50 was eight minutes; the shortest 6¼ minutes. The entire 300 were done in 38 minutes. A test repeated several times shows the time necessary to fully charge this Pacific tube, using 50 Winchester #111 primers: maximum time, 52 seconds; minimum time, 46 seconds—on five tests. It will be seen, therefore, by comparison, that the resizing and priming operation is nearly cut in half

In seating bullets with the Pacific, one merely unscrews the resizing die and replaces it with the necessary bullet-seating die. He then inserts the cartridge case containing the charge of powder into its proper position in the upright shell holder, places a bullet over the mouth of the case, and lifts the operating handle, thus riding the cartridge into the seating die. When this is withdrawn, the bul-

let has been seated to the proper depth, and a uniform degree of crimp (if desired) has been placed on the mouth of the cartridge case.

This crimp cannot vary, regardless of the speed of operation or the energy the handloader expends on the tool, as it is predetermined or omitted at the will of the reloader through the setting of the



Straight-line bullet seater and shell resizer designed and manufactured by L. E. Wilson of Cashmere, Washington, for his own use. Units as marked are: (1) adjustable cap for bullet seating, (2) plunger for case neck resizing, (3) bullet seating die, (4) body of the tool with neck die in position, (5) sleeve for holding case in straight line within the tool, (6) die and reamer die for use in reaming case neck, (7) the case neck reamer. A punch for removing resized shells from the neck die is not illustrated. In use, the unit No. 5 is slid into the case neck body part No. 4. The plunger No. 2 is used to force the case and its sleeve to proper depth in the neck sizing die shown at the bottom of the body No. 4. If it is desired to ream case necks, the neck-sizing die is placed with No. 6, which is also a neck die but has an unusually long pilot to permit of reaming and trimming the cases while still clamped solidly in the die. An extreme precision tool

dies. At normal speed, 50 bullets can be seated in from five to six minutes, thus making the tool efficient for quantity loading. The Pacific is available with ordinary soft steel dies carbonized on the wearing surfaces, or with accessories made of high-speed or tool steel. The latter, of course, costs slightly more.

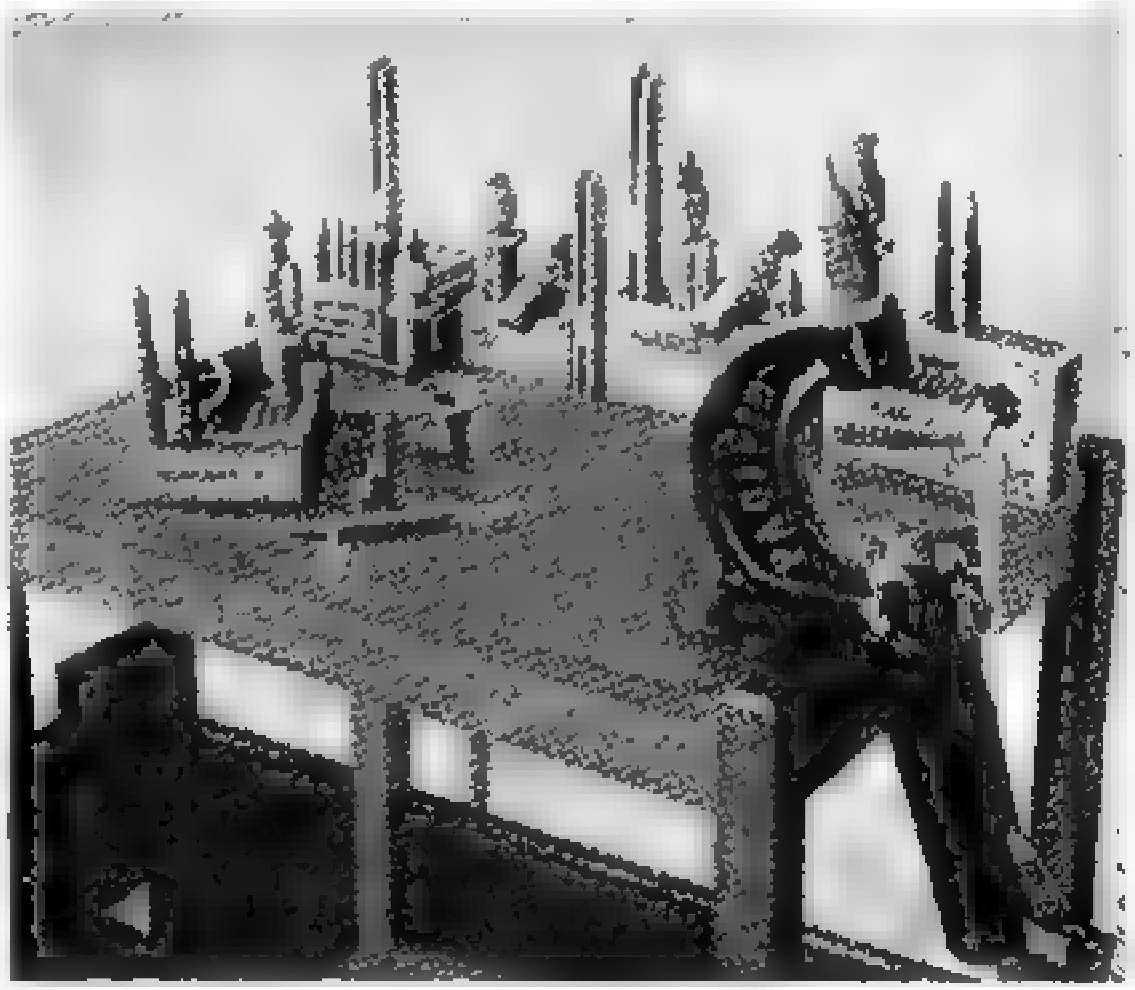
One of the major features of this tool is the fact that various accessories—or units of them—can be set in proper position and locked by means of a set screw. Even the so-called lock nut which predetermines the depth to which the dies are screwed into the tool body may also be locked into position. This is of extreme importance, as the operator may predetermine his setting and leave it entirely alone despite the necessity for shifting these dies from the machine body in handloading various calibers.

The author has one set of .38 Special dies designed with bullet-seating punches fitting a certain type of bullet which he uses very frequently for target work. That set of dies has never been removed from its initial adjustment despite the fact that it has been used for several thousand reloadings during the past five years, and the same tool body has been used for a similar number of reloadings in different calibers. The "setting up" of this tool is, therefore, unusually simple.

Bond Model "D." This is one of the newest of loading tools and is unusually well designed and built. R. W. Bond, president of Modern-Bond, is himself a very enthusiastic reloader, as a visit to his office will clearly indicate. Although we do not care for his Model "C" tool and have never recommended it either in published material or in correspondence, we wish it clearly understood that the Model "D" is in no way to be compared with previous Bond tools, nor are any of its parts or dies interchangeable.

This new tool is of the bench type. It can be operated by holding it in position with one hand, but this is slow and inefficient. It should be attached to a bench by means of bolts or screws. The base of the unit is cast of malleable iron or semi-steel, and other parts are of various types of steel meeting the requirements of their several purposes.

The Bond Model "D" tool made its first public appearance in mid-1935, although its designing was known to a few writers as much as a year



Some of the author's Pacific Tool's assorted dies, shell holders and other accessories used in reloading different cartridges

before its release. It is extremely simple to operate, and the various dies are so rapidly interchanged as to be practically fool-proof. The author used this tool for several months reloading for the .38 Special. At present this tool is manufactured for the .38 Special, .357 Magnum, .38 Auto, .45 Colt, .45 Auto, and .45 Auto-Rim. In the near future vari-

ous other handgun and short rifle calibers may be available.

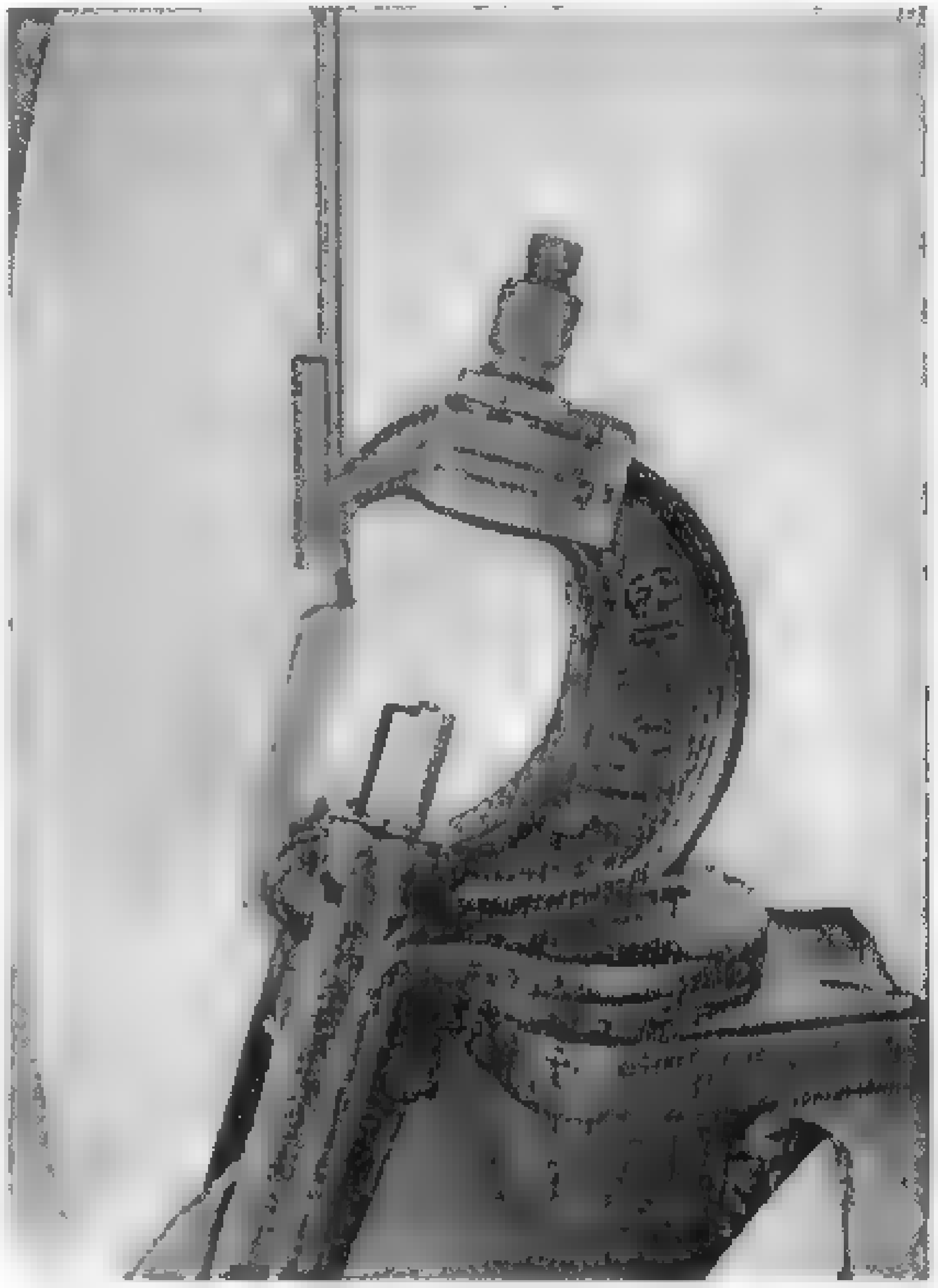
The first operation of this new tool is the resizing and decapping of shells. The spring "horseshoe" holds the shell holder in position at the top of two sturdy upright rods. By means of a cam arrangement, a cross arm containing the dies is raised by a forward pull on the operating lever, thus forcing the suspended shell into the die, resizing it outside for its full length, forcing out the empty primer and removing the old crimp from the mouth. The downward pull frees the shell, which may then be picked out with the fingers. The work is extremely speedy, and with reasonable skill can be stepped up to actual quantity production with very little effort. Notes indicate that the author's first attempt at using this tool resulted in decapping and resizing 100 cases in 12½ minutes.

Faults of This Tool: Very simple in design and very well built. Resizing shells, however, causes brittle débris to flake off the inside of the shell, and the mouth-down position of the empty cartridge case during the resizing operation permits this débris to drop into the die. At intervals of about fifty shells, the die should be removed and emptied to eliminate wear and possible mutilation. This takes no longer to do than it does to read about it. One merely pulls out the horseshoe-like spring, lifts out the die, empties out any possible accumulation, and replaces it.

The second operation is the priming of the shells. The shell holder and resizing die are removed and the former replaced with the priming head attached by means of the horseshoe lock to the upper crossarm. The movable arm actuated by the cam slides upward on the two rods, but the resizing die is replaced with a loading "table" reminiscent to the old Frankford Arsenal bench priming press. A bushing cut-out in front, similar to the FA unit, holds the shell while the primers are dumped on the circular table in bulk and slid into position by means of the left forefinger. The operation is quite speedy. The same test previously mentioned shows 100 shells primed in 11½ minutes.

The shell is then ready for insertion of the powder charge and the seating of bullets. Bullet-seating with this tool requires a third set-up of dies and is not only unique but also about as excellent an idea as anything we have yet seen. The priming head in the upper crossarm is replaced merely by pulling the horseshoe spring, with the entire unit adjustable, of course, and having an adjustable stop shoulder attached. In the movable arm is placed a new type of shell holder cut away in front. The cartridge case filled with powder is dropped into this pocket gently to avoid spillage of powder and a round steel bushing dropped over it. This exactly centers the shell.

The bullet is inserted base-first into this bushing with no regard for the shell beneath, whereupon the operating lever is pulled, causing the unit to



The automatic primer feed attached to the standard Pacific Tool. Note primer magazine. Shells are primed in the conventional way, but primers are automatically fed from the magazine when the primer holder is returned to position, eliminating the necessity for handling primers with the fingers

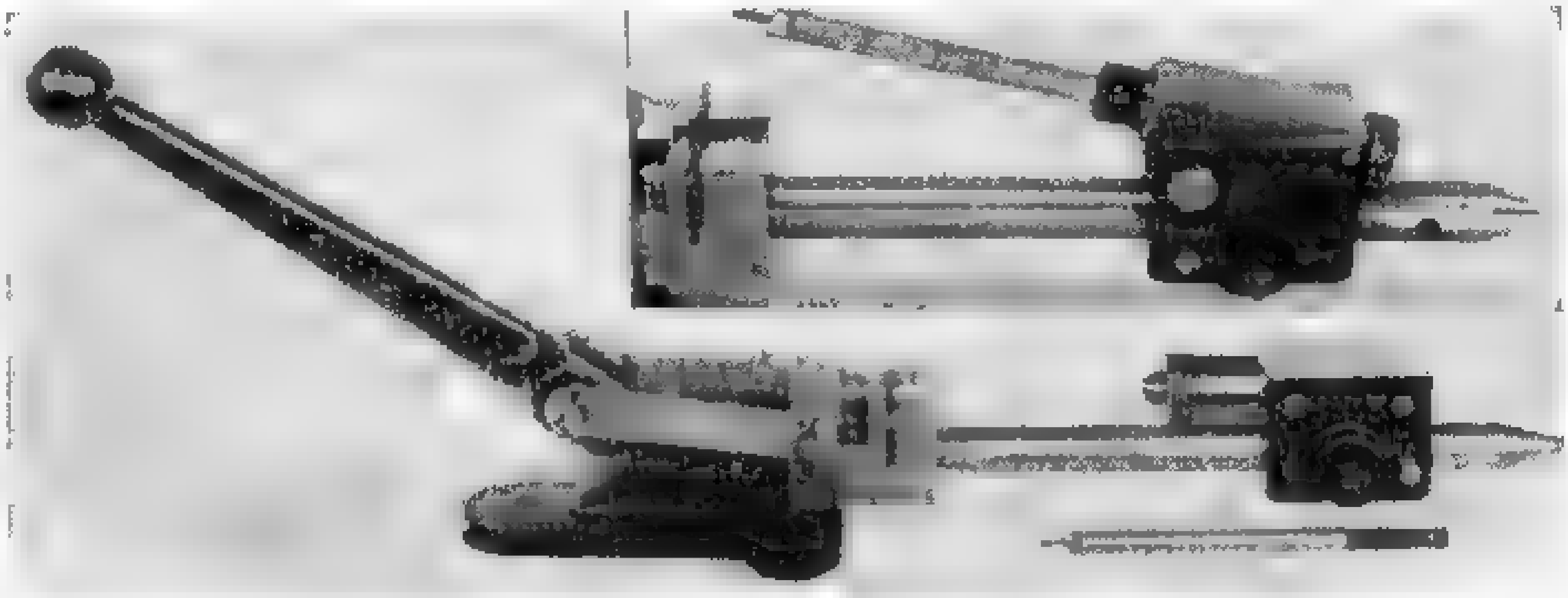
rise until it contacts the seating plunger, which forces it to its proper depth in the cartridge case. Slight additional pressure causes the bushing to contact the stop shoulder or crimp nut on the seating plunger, thus forcing the bushing down over the shell lightly. Since the bushing is counterbored and beveled, the downward pressure of the bushing forms a perfect crimp on the mouth of the shell.

Criticisms: None except that the operator must drop his powder-filled shell into the holder pocket about two-thirds its length. No need of spilling powder if care is used, but almost certain to occur if operator gets careless. It insures accuracy of

handgun loads through uniform crimp, whereas most tools are inclined to place more of a crimp on one side than on the other. A speed test on first trial showed that 100 bullets were seated in 16 minutes with spillage of a small quantity of powder from two shells, necessitating the withdrawal and the remeasuring of two new charges.

This same tool can be used for bullet sizing by replacing the shell holder with proper bullet-sizing dies.

Perfection. This tool, although rarely encountered in this day and age, is still one of the best bench tools ever built. It was made by Hueter Brothers, 1230 Ninth Avenue, San Francisco, beginning in the early 1900's, and chiefly for the .30/40 Krag cartridge. Later it was adapted to other calibers through additional dies. About all I know of the Perfection was gleaned from a visit with my good friend Harvey A. Donaldson, noted gun bug, experimenter, and writer, who had used one for years.



The Belding & Mull Model #26 Loading Tool, set up for resizing and expanding. Insert: decapping unit

This tool was the forerunner of the Pacific, and the firm was purchased many years ago by the Pacific Gun Sight Company. As soon as this firm absorbed the Hueter outfit, it dropped this fine tool instead of refining it in a few minor ways. Perfections have been used by many of our best-known experimenters, and not one who has reported to the author has had anything but praise for its performance. It was built along the lines of a drill press—a round base, an upright, and the various dies below where a hand lever could do the work, always under the watchful eye and complete control of the operator.

Universal. A development of 1935 was the Universal, designed and built by the Universal Loading Tool Company, of 2690 Kettner Boulevard, San Diego, California. This firm apparently has two expert machinists, Lindsey King and S. R. Siebert, who think enough of their individual work to stamp names on dies and other parts they make. The workmanship in the various dies is superior to anything the author has ever seen in any loading tool. This outfit costs money, but looks more like a labor of love than something to sell.

Essentially the Universal is a glorified version of the Pacific. It looks nothing like it, but the principle is the same. The tool is a heavy bench affair weighing 45 pounds. On top is a turret which can be rotated 60 degrees to three positions, exposing as many dies or gadgets to the single vertical plane of the shell holder. Slip a shell in this holder, rotate the turret to the left, lift the lever, and the shell is forced into the die, full-length resized, mouth expanded, crimp removed, and decapped. You then drop a primer into a fixed-position priming cup, and lower the lever, pulling the case from the die and down over the primer.

Then, without touching the case, rotate the turret to the center position, raise the operating lever, and you run the case into a snug-fitting chamber, on top of which is mounted your favorite powder measure. Operating the measure handle causes the charge to drop directly into the shell, dispensing with the use of the customary draw tube. The lever is again lowered slightly, and the turret rotated to the right once more, exposing the left-hand die—the bullet seater. The seating is conventional, and when you take the case from the shell holder, it is a completely loaded cartridge.

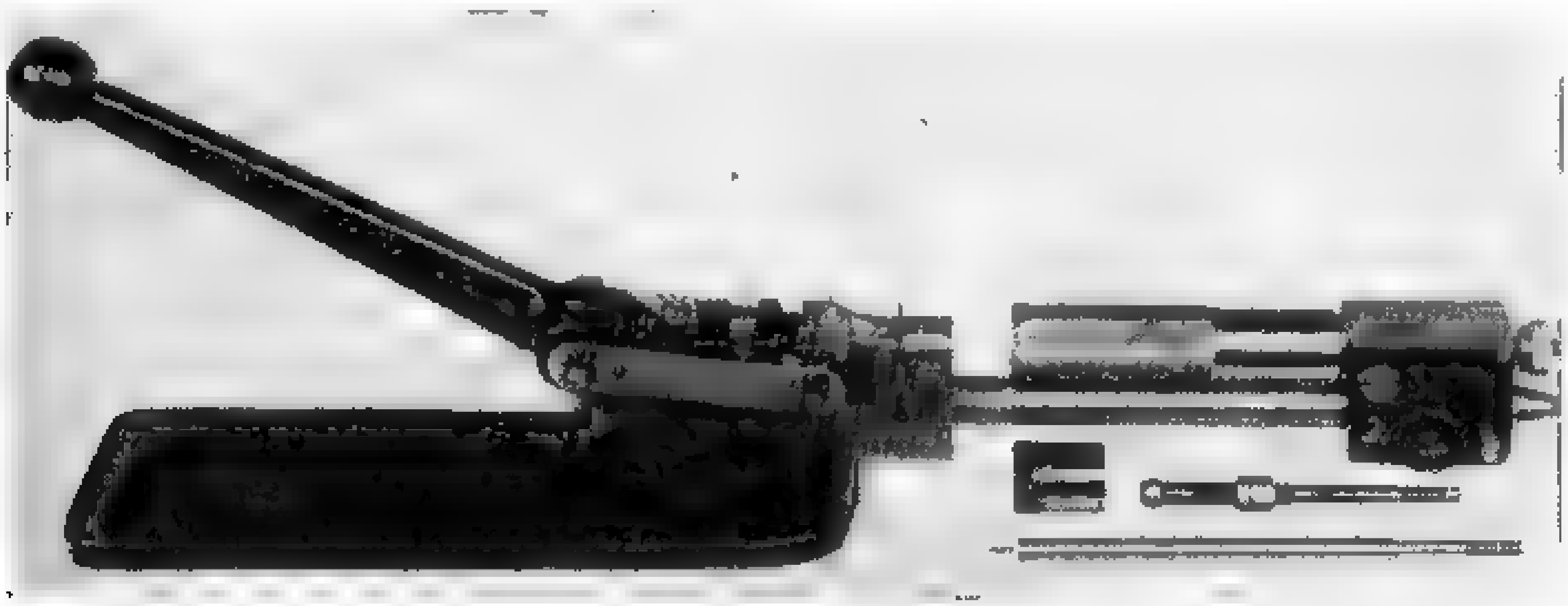
I have for many months used this tool in .30/06 and .38 Special and find it extremely fast. The extra-fine workmanship in the dies, with their minimum tolerances, gives a precision load hard to beat. I suggest, however, for reasons mentioned elsewhere, that the operator make no attempt to run through all stages of the operation at one sitting, but be content to throw powder charges and

seat bullets at one operation and do all of his shell resizing and priming at a different time. Loading machines in modern factories combine the measuring of powder and seating of bullets, but the new primed cases are completely prepared as they are fed into the loading machine.

The handloader will do well to heed this suggestion. A certain amount of effort is required to force the case into the die, decap, extract, and prime, and this causes a jar to the powder measure which cannot help but settle its contents. Thus uniform charges are more difficult than when the measure is handled carefully.

in short, straight cases, the Universal lads have designed a clever aid to speed and accuracy in the form of a bullet holder built into the seating die. Three holes are drilled into the mouth of this die, equidistant around the rim. Steel balls fit into these holes, backed by a light ring spring. To seat a bullet, push it into the die with the fingers—the steel balls will center it accurately and hold it until the shell with its charge of powder is entered.

At the same time, the bullet-seating plug is drilled through the top center, and a brass "indicator" rod with a knurled top is inserted. This rod drops into the chamber, and rises the length



Belding & Mull Model #28 Loading Tool set up for bullet seating in the .30/06. Various accessories are shown for neck sizing, expanding, and decapping

The Universal dies are polished and lapped, inside and out. Their threads are beautifully cut, so that they fit snugly into the heavy crinkle-lacquer finish of the big cast-iron frame. The toggle arrangement is operated by two bars, both exposed, and these, together with the front of the track in which the shell-holder table rides, are as beautifully engine-turned as might be expected on a display model. Dies are heat-treated in an electric furnace, as are all other operating parts working under strain.

The decapping pins are a work of art. Instead of the conventional cap nut holding a glorified nail, these are long tool-steel sleeves, nicely shaped with the decapping pin turned as a part of the sleeve. A long body thread and a hole for the insertion of a nail or rod to serve as a wrench are located both in the sleeve and in the expander body. They are tempered and drawn to a beautiful straw color, possible only in an electric furnace. Due to their design, they cannot come loose, and a solid pin cannot bend or break in normal service. Remember that, you chaps who keep bending your decapping pins.

For the seating of handgun bullets, or for bullets

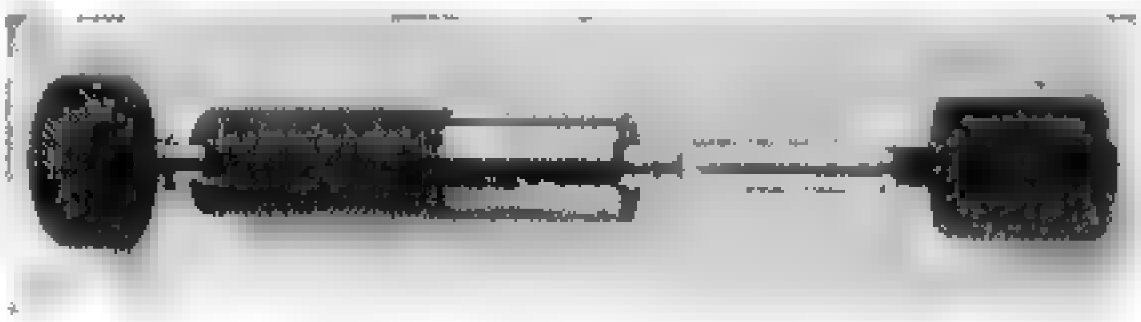
of the bullet as it is inserted. Thus you can tell at a glance if you forgot to insert the bullet before you run the shell into the seating die for the crimping operation. It saves time, prevents shaving of bullets, and gives beautiful crimps—adjustable, of course. All seating dies are ventilated with a fine hole or two, to permit the escape of air, thus insuring uniform seating depth. A very excellent tool, and one a handloader would be proud to own and display to his visitors.

Jordan. Developed in 1935 by L. W. Jordan of the Union Auto Specialties Co., Brookfield, Pennsylvania, this popular tool was one of the many items which passed through a process of evolution and through different manufacturers. In 1946 the manufacture was taken over by the Cameron Manufacturing Corporation of Emporium, Pennsylvania. The latter part of 1947 the Masters Machine Works of Brookville, Pennsylvania, undertook the production of the tool, refining it to a top quality item with a wide variety of precision dies, chrome plating, and other refinements described in detail in the supplement of this volume.

This press is about as much of a straight-line tool as one can get in the entire loading-tool family,

and is equaled only by the Schmitt system of case-guiding the cartridge while the bullet is seated, and the similar system employed by Wilson of Cashmere, Washington, with his seating tool supporting the case body during the operation, and Potter with his special rifle dies.

The Jordan is no toy. It weighs about 18 pounds, has a heavy cast-iron base 6 inches in diameter, supporting an upright post of machine steel 1$\frac{3}{16}$ inches thick. Riding on this heavy post is a table 3¼ inches in diameter and 3⅜ inches deep, holding the various dies. At the bottom is a similar table 1½ inches thick. Both of these are of cast iron nicely machined. Cast iron, working against steel, gives a much better bearing than two similar steels, and the great length of the upper or



An excellent hand bullet seater of Belding & Mull manufacture designed for use with the Model #26 tool. Various of these units are used by the author in seating special bullets, as it is capable of first-class work. It can be used to crimp or not, as desired, and is readily adjustable for seating depth. The cost of these tools is exceedingly low

movable table means a long bearing to reduce wear and distribute friction.

The unique feature of this tool is that it is continually set up for all operations of handloading in two calibers, if desired. To change from one caliber to another, it is only necessary to use the proper set of dies. This has never been done on any other tool so far as I know. I've used mine for many months, in .30/06, .38 Special, .357 Magnum, .44 Special and .220 Swift. The first set of Swift dies for this tool were made at my direction, and work perfectly, full-length resizing the cases with very little effort, so that I may use them in either my Standard Winchester rifle or my heavy-barreled custom-built job by Sweany. This tool is kept set up at all times for the .220 Swift and for the .357 Magnum.

For shell resizing, you slip the fired case into the shell holder, pull down the lever, and a powerful toggle forces the sliding table with the resizing die down over the case, full-length resizing, or neck sizing, decapping, and expanding. Raising the lever extracts the shell from the die, where it is picked from the holder with the fingers. The primer is then dropped into a cup in this table, and the cartridge case placed over it. A slight rim, fitting the head of the shell, centers the case so that when the operating lever is pulled down the plunger enters the case mouth and forces the case over primer. Adjusting the plunger insures uniform seating depth of the primer.

With a charge of powder inserted, the really novel features of the tool are brought out. Moved to a different shell holder beneath a seating die, the lever is lowered part way, whereupon a sleeve drops over the case, gripping it solidly. A port on the side of this movable table is exposed, and a bullet dropped into the sleeve, base down. There it is guided into the neck in precision manner, the sleeve holding the case solidly throughout the seating operation. A similar sleeve holds the case body during resizing, the sleeve there actually serving as a *body*-sizing die with a separate *neck* die. The neck is first sized while the sleeve or body die holds the shell, whereupon the continuation of the downward lever movement forces the body die over the shell. In extraction, the neck die is withdrawn first, the expander pulled through, and then the body die removed—a precision group of operations at production speed.

Jordan also has available a bullet-sizing die and lubricator for direct attachment to this tool, making a very accurate and speedy bullet-sizing equipment. The bullet is dropped point downward into the guide sleeve supplied, and as the lever is lowered, it is forced into the sizing die. The lubricant is then forced into the grooves of the bullet by means of a miniature Alemite gun attached to the movable head or turret. As the lever is closed, the bullet is forced free of the die and brought to the top, where it is picked off with the fingers and packed in a suitable container.

The sizing die fits in either of the bullet-seating stations of the press and may be attached or detached in a few minutes. The lubricator itself is interchangeable with any number of dies supplied by Jordan for various bullets, and handles the 1-inch diameter stick lubricant supplied by various loading-tool makers and supply houses in a variety of mixtures.

Potter Duplex. One of the newest developments in the loading-tool field is the Potter Duplex, designed and manufactured by the Potter Engineering Company, of 10 Albany Street, Cazenovia, New York. This firm operates under the direction of Arthur Dick Potter, a mechanical engineer who is a gun bug of the first order. He knows loading tools and the loading-tool problems, and my first acquaintance with him was through Fred Ness, of the *American Rifleman* staff.

There is no *perfect* loading tool on the market,

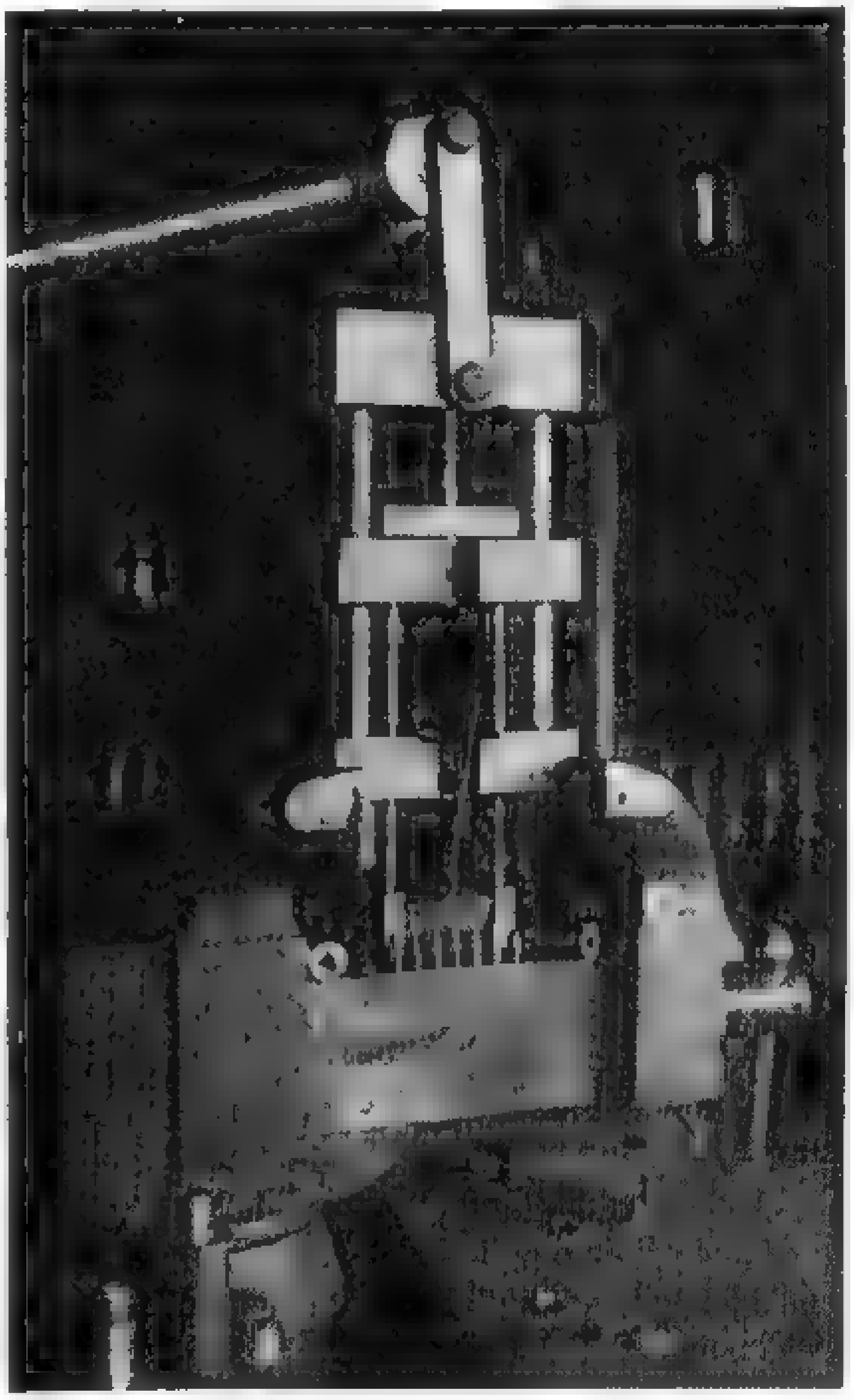
and Potter realizes this. Accordingly he develops his version of what a loading tool should be. It has one particular feature which, of no importance to some people, is extremely appealing to the author. Most handloading tools have an annoying habit of discarding the primer in almost any direction where it will land under foot on the floor or bounce around the community. Potter effectively takes care of this. The tool is bolted or otherwise firmly attached to a bench, table, or other solid support. Primers are discharged into the base, and any ingenious handloader can make a hole in the bench top and run it through to convey the spent primers to some form of box or receptacle underneath. This is not necessary, however, as that base will accommodate several thousand primers before it needs to be emptied.

The Potter Duplex, generally speaking, is of the familiar straight-line bench-press type. It does not, however, look like any other make of loading tool on the market today. A cast-iron base forms the support, and this is sufficiently sturdy so that when I first attempted to use it I found that it could be readily operated without bolting down. Any bench tool, however, should be solidly attached to the top of the bench to prevent slipping around, and to allow perfect control of the operating lever during the resizing of shells and seating of bullets.

This large cast-iron base has a diameter of 7¼ inches and is about 5 inches high. Its top is milled to a flat upon which the shell-holding and recapping equipment is properly mounted. From this base rises the 1¼-inch steel-rod upright, supporting the superstructure with a powerful double toggle operating a sliding head into which the dies are screwed. This sliding head has a 4⅜ inch bearing and has take-up facilities to properly adjust for any wear which might occur in extensive handling. The long bearing of cast iron against the steel rod should insure extremely long wear and freedom from trouble.

From the side of the fixed head or superstructure projects an arm which can be removed if desired. This arm supports a powder measure of Potter's own design and manufacture. It is of the general hopper type, the entire unit being formed of cast iron and similar in operation to the Bond. This measure may be operated at the same time that shells are resized to throw a charge of powder into a waiting case, if desired. It is only a moment's work to disconnect it entirely, and a special table bracket may be obtained to permit attachment of this Potter measure to the bench

The measuring cylinder or metering chamber may be varied and must be set for a given charge by means of a balance, and is then supposed to remain fixed until it is desired to change again. Additional cylinders, however, may be obtained to be set for other fixed charges. For rifle charges, a calibrated cylinder can be furnished on special



A tool maker builds a reloading tool: J. B. Sweany, noted experimenter of Winters, California, designs a straight-line tool with die supports, for experimental work in the .220 Swift. Note various dies seated on loading bench, also plate of heavy steel used for 500-yard .220 Swift penetration tests

order. This particular measure can be set for any given charge of powder at the factory, on order. Special non-adjustable cylinders for any other given charge can be obtained. This, of course, would eliminate the necessity of using a powder balance for checking the setting.

An automatic primer feed is standard equipment on this new tool. The magazine holds 100 primers. The sliding head holds both the bullet seater and shell-resizing die at the same time, and there are two positions in the shell holder to accommodate

cartridge cases. The first operation includes the downward movement of the operating handle. This forces the shell-resizing die with decapper over a cartridge case. The operating handle is then raised to withdraw the decapping pin from the primer pocket, and a small priming lever on the left-hand side of the machine is pulled forward, discarding the decapped primer by carrying it out through a special hole in the base of the tool, then moving a new primer from the magazine into

The present Sweany tool made for J. Bushnell Smith. This is Sweany's "commercial" model

proper position, and forcing it home with the primer-seating punch.

The primed shell is then removed from the first position, held beneath the pouring spout of the powder measure, and the handle operated once more, which discharges the proper charge into the case. It is then placed in the right-hand side of the shell holder, under the bullet-seating die; a bullet balanced on the neck; Station 1 refilled with a fired cartridge case; and the operation repeated. As the cycle continues from this point, a complete cartridge is delivered at every throw of the operating lever.

The powder measure is so hooked up that the operating lever must be thrown all the way to the rear to cut the metering drum into the powder charge. If the lever is brought to the upright position, which raises the die sufficiently to handle all handgun loads, the powder measure is made inoperative, so it is a simple matter to leave the powder measure properly cut in without actually spilling any powder.

The tool is so hooked up that any of the operations necessary to handloading can be conducted separately without creating any complications. This is not true of some of the other tools on the market. If, for instance, you should decide to resize and decap your cases without repriming, no change in the set-up is necessary, and the only alteration necessary is to remove your charged magazine of primers. The magazine is built with a cut-off so that it may be left in position and merely cut loose from feeding if desired.

By the same token, to reprime properly resized and recapped shells—if you desire to clean the pocket before this operation—is really very little additional work. One merely slides the properly treated empty shells into position, operating the auxiliary or priming lever on the left side of the machine forward and backward, and the job is done just as fast as you can feed them in. Ditto for bullet seating.

The resizing dies used by Mr. Potter are of a design extremely interesting to the handloader. They are merely ground and hardened tool-steel bushings screwed into the die body. The change of worn resizing dies necessitates the expenditure of only 75 cents. Complete description of the other dies is impossible at this writing as the tool is undergoing a few minor changes at the author's suggestion. Mr. Potter is endeavoring to simplify his dies to meet the ever-present problem of the handloader—additional dies for different calibers and styles of cartridges at a minimum price. On one make of bench tool, for instance, the author discovered, on making his inventory not long ago, that he had more than $75 worth of additional dies for various calibers of cartridges. This particular amount of money had been invested by the simple process of adding equipment for a new cartridge now and then. Until the actual check-up, he hadn't realized how much money had been spent.

Mr. Potter has designed a very excellent tool and one which has the appearance of being sufficiently sturdy for heavy production of quantity loading. At the same time it permits of the finest precision for the chap who desires to load twenty-five or thirty cartridges of a given type at one time. With proper dies on hand, the changing of set-up from one caliber to another is a matter of less than three minutes.

Hall Bench Tool. A 1936 newcomer to the handloading tool field was Fielding B. Hall, of 1322 Montana Avenue, Los Angeles, California,

with a bench-type tool having many desirable features. This particular tool is of the horizontal straight-line variety, on the same general operating principle as the Schmitt, but differing tremendously in detail.

The Hall tool I tested was for the .30/06 caliber. It is unusually sturdy, with a steel frame supported on four cast-iron legs at the corners. The design is such that should the legs become accidentally broken, they can be replaced inexpensively without necessitating alterations of the tool proper.

I first used this tool in the early winter of 1936. I found it entirely practical for work at hand, particularly where reasonable quantities of ammunition must of necessity be loaded. A job requiring assembling of a small quantity such as twenty of a given load with the various tear-down steps between the operations makes this rather slow to handle.

Special tool-steel dies of precision manufacture are supplied. The tool is sufficiently powerful to full-length resize .30/06 shells without undue effort. The resizing die and shell holder are held in position in a large sliding block riding on a bed similar to that used in a lathe, this block being 1¾ x 1⅞ x 2 inches, whereas the rails or tracks on which it slides are ½ inch thick and ⅞ inch wide. The entire tool is between 18 and 20 inches long and will occupy that amount of bench space.

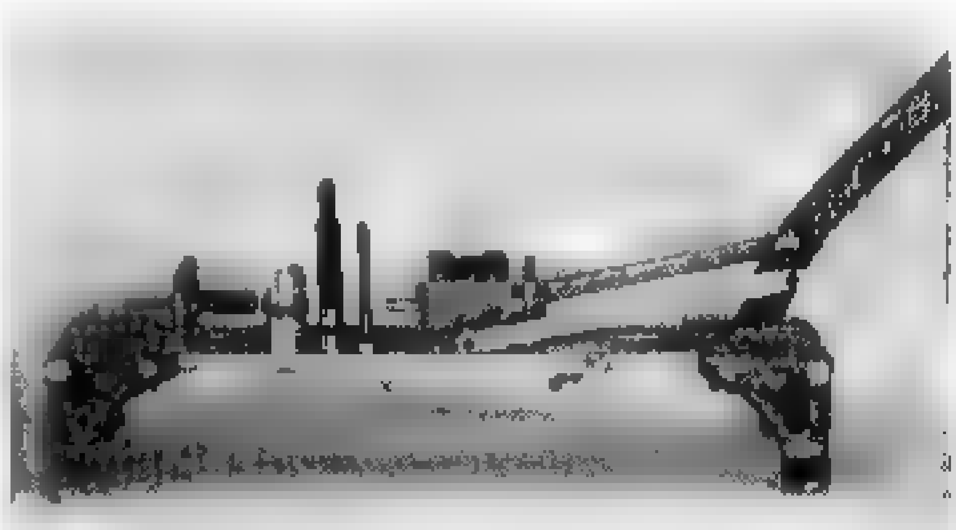
The front die holder is threaded to accept a neck-expanding unit and bullet seater. A special decapping pin, which is also used to drive the case out of the sizing die, is installed in the rear die holder and the recapping pin is properly shaped so that it may be used to swedge out primer pockets of Frankford Arsenal make when that unfortunately inconvenient ring crimp has been used around the primer to hold it in position.

The operating handle of the Hall tool is a sturdy steel lever two feet long. It is located near one end of the base. It was found that little effort was required in this powerful tool for full-length resizing. It is of extreme importance that as many cases as possible be put through at one time. Setting up the tool for different operations is slow and painstaking work, although no more so than with the majority of other tools on the market.

The very excellent resizing die is equipped with three tiny vents at the neck to permit the escape of air. Since it is always advisable to oil cases lightly by wiping them with an oil-dampened rag, these vents prevent "oil buckling" of the case due to surplus oil collected therein. The surplus merely exudes from the die.

Another feature of this resizing die is that it is properly constructed to eliminate the dangers of increasing headspace. This is extremely important in high-power rifle cartridges. With many of the tools on the market, if the cartridge case is forced too deeply into the resizing die, the shoulder is altered slightly or moved back, thus creating a serious problem of headspace.

The Hall die cannot be used in this manner, as the case is forced into the die until the head is flush with one end. Visible inspection of the opposite end of a die indicates whether the shell has stretched, as this die is made of the proper length so that no part of the neck should protrude when fully seated. These sizing dies are made by F. K.



The Hall Bench Loading Tool, designed by Fielding B Hall, of Los Angeles. Horizontal operation permits of full-length resizing of .30/06 cases

Elliott, noted toolmaker, who has always been famous for his precision work.

Although originally brought out for the .30/06, Hall advises, as these pages are going to press, that this tool can be obtained with dies for many of the popular rifle and revolver cartridges.

Jayne Strayt-Lyne. A 1937 offering is the Jayne Strayt-Lyne, designed by Robert L. Jayne, Skinners Eddy, Pennsylvania. This Jayne tool is made only in .30/06 and .30/40 caliber at the present time, but may soon be made available for other cartridges.

The Jayne tool is of the bench type and is probably the smallest and lightest of bench tools now available. It is economically priced and should make a fine piece of equipment for the man who limits his loading to a single caliber.

The dies are held rigidly in a swivel head and the light toggle forces the shell into the die from a rising shell holder, operating upon a steel rod ¾ of an inch in diameter. The base is of cast iron, enameled with pleasing gray, and the turret head is also of cast iron similarly painted.

A novel device is that for the handling of shells. With this tool bolted down to the bench or attached by means of long wood-screws, there is not sufficient clearance for a full throw to handle a car-

tridge case such as the .30/06. Locked in position for shell resizing, there is slightly less than 1½ inches clearance between the shell holder and the mouth of the sizing die. This die consists of a steel sleeve holding the die itself, but is intended only for neck resizing. There is not sufficient power in this particular tool to permit of full-length resizing.

The steel rod upright swivels in the base. The cast-iron head or turret is firmly locked to a desired position by means of a special steel set screw. To use this tool it is necessary to turn the turret to the left, insert the shell into the die by hand, then rotate the head to the right until the extractor groove slides into a special open-end shell slot. To remove this shell one again rotates the turret head to the left slightly, after extracting the shell from the die, whereupon it drops into the hand. It sounds slow, but we found that with a little practice it becomes sufficiently speedy to satisfy any handloader.

The clamp nut holds the resizing die in position, and it is necessary to release this die and replace it with a bullet seater to handle the second stage of the operation. At my suggestion, Mr. Jayne is making up a new tool with a compound head so that bullet seating and resizing dies, after once being adjusted, can be left in position, thus eliminating tear-down operations. Naturally this tool will cost slightly more than his present model, but the advantages make it more desirable in every way.

Ward Turret Tool. An interesting tool developed in mid-summer, 1936, was the Ward, designed by J. B. Ward, 412 Piñon Street, Walsenburg, Colorado. At this writing the tool has been withdrawn from market, owing to patent difficulties; but it is expected that these will be straightened out in the near future.

Essentially this tool is of the revolving turret type. It has a cast-iron base supporting two half-inch rods or uprights upon which a rotable turret holds adjustable dies. On these two rods a sliding adjustable shell-holder unit travels in a vertical path.

The fixed head holding the turret is also adjustable for height, depending upon whether one desires to handle long rifle shells or short handgun varieties. To change the position, it is necessary to release two large nuts on top or bottom and tighten those below the turret. Care must be taken to see that the adjustments are made in perfect line. With reasonable care there is no cramping of the turret head in making these adjustments.

The revolving turret has four different stations which handle all the various dies and units, including an attachment for powder measure. Assuming that the tool is set up for handloading, its operation is extremely simple. The fired shell is fed into the shell holder and a long operating handle controls the toggle arm which rides the shell holder upward on the guide rod and seats the fired case into the resizing die. This decaps the shell in a conventional manner. An upright primer holder attached to the fixed base is then supplied with a primer by hand. As the shell is withdrawn from the sizing die the reverse motion of the operating lever rides down, forcing the primer into its pocket very neatly. This can be adjusted so that the primer is always seated to a uniform depth.

This operation performed, the turret is rotated to position No. 2 without touching the shell and the hand-lever operation repeated. This runs the expander into the cartridge case, removing all traces of crimp and slightly belling the mouth of the shell, if desired. This, of course, is adjustable to any degree desired by the operator.

The shell is again withdrawn and the turret rotated to position No. 3, which consists merely of an adapter for an Ideal powder measure. Riding the shell into a proper receptacle there permits one to drop the charge of powder directly into it, by operating the Ideal throw lever in the conventional manner. The shell is withdrawn once more and the turret rotated to stage No. 4, which brings the bullet-seating chamber in line. The final operation seats the bullet and crimps it if desired.

A very useful feature of this tool is the fact that dies drop into proper pockets in the turret holder instead of being screwed into position. It is a simple matter to remove them in just a few minutes. At the same time, with predetermined setting on the adjustment, it is not necessary to tamper with them during the different loading operations.

Another unique feature is the shell holder. This differs from anything on the market in that a single shell-holder unit built into the rising table enables the same tool to handle, without adjustment, every shell from the .22 Hornet up through to the .375 H. & H. Magnum series. This consists of two V-shaped knives backed by springs. These knives properly grip either the rim or the extractor groove, depending on whether one is using rim or rimless shells. If one desires merely to prime with this tool, it is not necessary to make any change, other than in primer-seating punches for different sizes of primers. "V" knives are released by pressure of a finger on a plunger at one side of the table. Due to the design, these always perfectly center the shell. Adjustment is available

to take care of different rim thicknesses in certain calibers if necessary.

The tool I tested was very well made and I regretted that it was necessary for Mr. Ward to withdraw this item from the market. He hoped to adjust patent difficulties, but was unable to do this. Mrs. Ward wrote me that her husband died in 1946 of a heart attack. He always maintained a love for his tool, developing many special gadgets and accessories for this, but they are not mentioned herewith because it is not known whether they will appear upon the market. Many of these the author has been experimenting with for the past six months, including various types of reamers, shell trimmers, and guide chutes for conveying primer débris from the pocket away from working parts of the tool and particularly from the primer-seating punch.

XXIII

DIES AND GAUGES

A FEW scant years ago the handloading fan had few if any dies and gauges to aid him in his handloading. Today this problem is being recognized and rapidly cared for. Within the next few years there will be a great many more brought on the market.

Precision handloading depends not only upon the skill of the individual but upon the types of tools he uses. If he can afford to invest the money in handloading equipment he can greatly improve his product, and there is something about the ownership of precision equipment which in a great many instances causes a feeling of satisfaction that makes the investment well worth while.

No handloading fan should attempt to handload any type of ammunition without equipping himself with that basic instrument, the micrometer. This can be obtained at prices ranging from $3 to $25, and while the author does not care to recommend the very cheapest of instruments, he recognizes the necessity for a reasonable degree of precision.

Micrometers. The two most popular makes of micrometers today are those of Brown & Sharpe and the L. S. Starrett Company. Both are entirely satisfactory. One of the most practical of these micrometers, and one which the writer has used for many years, is the Starrett #113 one-inch micrometer with vernier reading to .0001 of an inch. It is even advisable to get your micrometer calipers equipped with a ratchet in the end of the spindle, although to a skilful operator this is not necessary.

The handloading genius will probably know more about the use of a micrometer caliper than the average machinist, strange as it may seem. I have been in various machine shops, garages, and so forth, and watched the efforts of dozens of mechanics trying to measure with this very common tool. It is astounding to notice their methods. Perhaps the best and simplest way to explain the use of a micrometer is to quote from the tool catalog of the L. S. Starrett Company.

"The pitch of the screw threads on the concealed part of the spindle is 40 to an inch. One complete revolution of the spindle therefore moves it longitudinally one fortieth (or twenty-five thousandths) of an inch. The sleeve is marked with 40 lines to the inch, corresponding to the number of threads on the spindle. When the caliper is closed, the beveled edge of the thimble coincides with the line marked zero on the sleeve, and the zero line of the thimble agrees with the horizontal line on the sleeve. Open the caliper by revolving the thimble one full revolution, or until the zero line of the thimble again coincides with the horizontal line on the sleeve; the distance between the anvil and the spindle is then 1/40 (or .025) of an inch, and the beveled edge of the thimble will coincide with the second vertical line on the sleeve. Each vertical line of the sleeve indicates an additional 1/40 of an inch. Every fourth line is made longer than the others, and is numbered 0, 1, 2, 3, and so forth. Each numbered line indicates a distance of four times 1/40 of an inch or 1/10 of an inch.

"The beveled edge of the thimble is marked in twenty-five divisions, and every fifth line is numbered from 0 to 25. Rotating the thimble from one of these marks to the next moves the spindle longitudinally 1/25 of 1/40 of an inch or actually one one-thousandth of an inch. Rotating it two divisions indicates two one-thousandths, and so forth. Twenty-five divisions will indicate a complete revolution or .025 inch.

"To read the caliper, therefore, multiply the number of vertical divisions visible on the sleeve by 25, and add the number of divisions on the bevel of the thimble from the zero line which coincides with the horizontal line on the sleeve. In use the frame is held stationary; the thimble is revolved by the thumb and forefinger, the spindle being attached to the thimble revolves with it and moves through the nut in the frame approaching or receding from the anvil on the opposite end. The article to be measured is placed between the anvil and the spindle and the spindle screwed down on it gently."

It is extremely important that one be careful not to strain the instrument. It is a very simple matter in measuring metal-jacketed bullets as small as .30 caliber to tighten the spindle sufficiently to register two or three thousandths less diameter than may be correct. Always open the spindle sufficiently to permit of careful wiping of both the

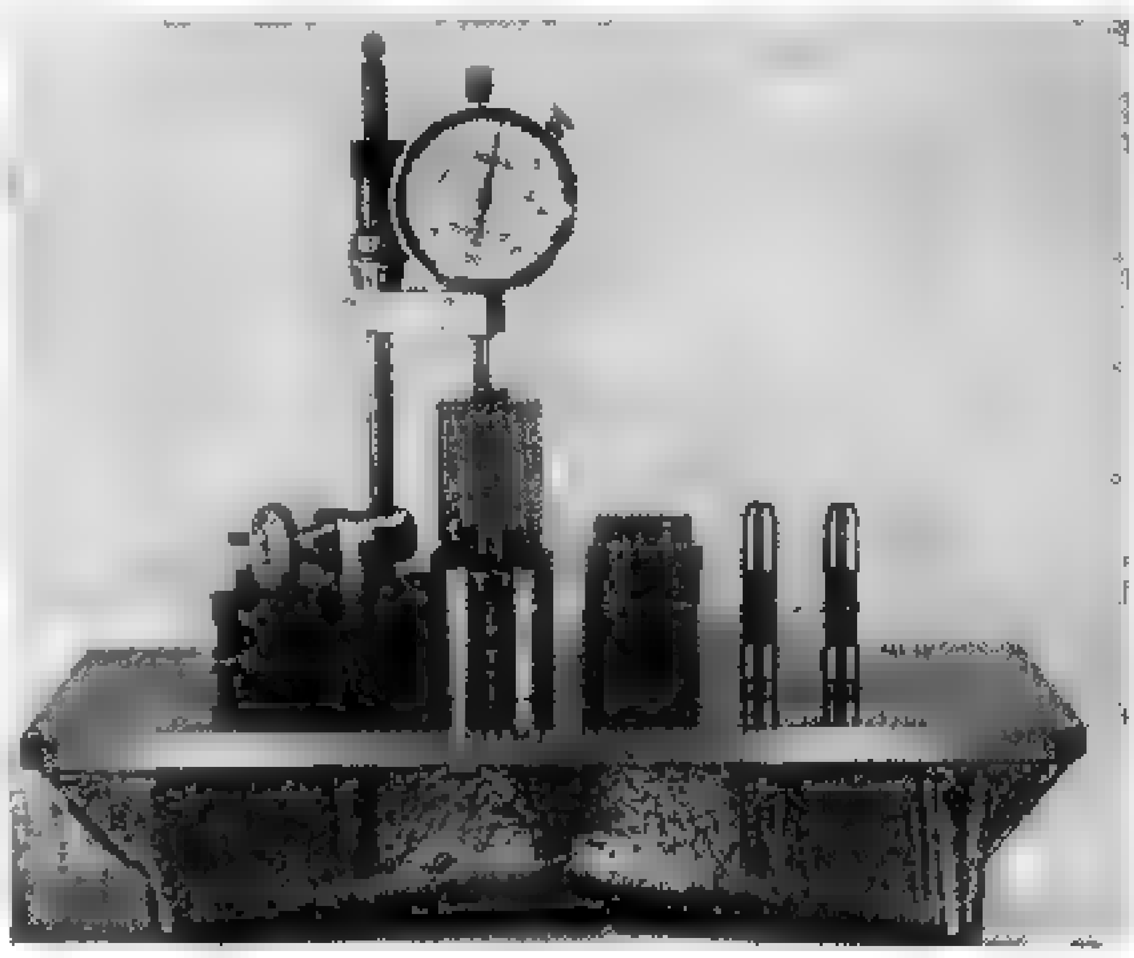
spindle face and the anvil, as an accumulation of a thin film of grease or dust can give a false reading as great as .002 inch. On lead bullets of the so-called cast variety, extreme care must be taken in the measuring, as it is quite simple to crush a lead bullet as much as .006 inch if too much pressure is brought to bear upon it. Not only is it possible to damage the micrometer in this fashion, but the measurements result in a false reading. Unless one can read the measurements correctly, he might as well refrain from taking them.

The handloading fan will find that his micrometer calipers are more valuable if the sleeve is graduated with a vernier to enable him to read to .0001 of an inch. Bullet measurements are frequently read in these small figures, and while a half-thousandth (.0005) can readily be estimated with the ordinary "mike," the proper use of the vernier eliminates the necessity for this. On page 240 is an illustration clearly indicating the method of reading the vernier on your micrometers; it is given here through the courtesy of the L. S. Starrett Company. Instructions accompanying a caliper so graduated read as follows:

"Readings in ten-thousandths of an inch are obtained by the use of a vernier, so named from Pierre Vernier, who invented the device in 1631. As applied to a caliper this consists of ten divisions on the adjustable sleeve, which occupy the same space as nine divisions on the thimble. The difference between the width of one of the ten spaces on the sleeve and one of the nine spaces on the thimble is therefore one-tenth of a space on the thimble. In illustration 'B' the third line from O on the thimble coincides with the first line of the sleeve. The next two lines on thimble and sleeve do not coincide by one-tenth of a space on the thimble; the next two, marked 5 and 2, are two-tenths apart, and so on. In opening the tool, by turning the thimble to the left, each space on the thimble represents an opening of one-thousandth of an inch. If, therefore, the thimble be turned so that the lines marked 5 and 2 coincide, the caliper will be opened two-tenths of one one-thousandth or two ten-thousandths. Turning the thimble further, until the line 10 coincides with the line 7 on the sleeve, as in engraving 'C,' the caliper has been opened seven ten-thousandths, and the reading of the tool is .2507.

"To read a ten-thousandths caliper, first note the thousandths as in the ordinary caliper, then observe the line on the sleeve which coincides with a line on the thimble. If it is the second line, marked 1, add one ten-thousandth; if the third, marked 2, add two ten-thousandths, and so forth."

Various instruments in both Starrett and Brown & Sharpe can be obtained, but calipers of about one-inch capacity will prove to be the most popular among handloaders, as they permit of the measuring of all kinds of bullet and case diameters. If the handloader cares to add a valuable tool to his present equipment, or if he has none available, he will find it quite practical to obtain—instead of the standard one-inch micrometer—a specimen of

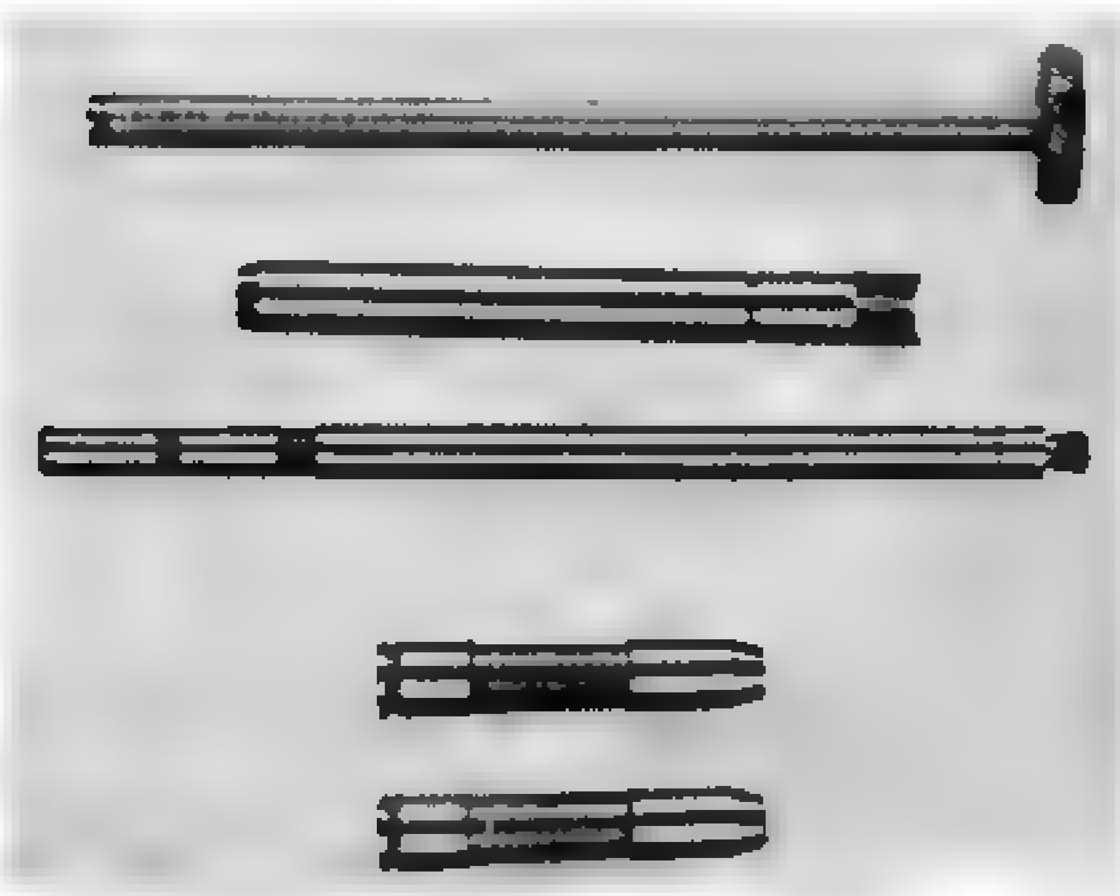


Some of the equipment used by L. E. Wilson, die and gauge maker of Cashmere, Washington, for the manufacture and testing of headspace gauges. The above set-up shows a surface plate, and at the left, on the surface plate, is a surface gauge with dial indicator. Headspace gauge in position for measuring. Lower end resting in special ring gauge and upper end held vertical by a support which is cut away to allow a stack of gauge blocks shown in the center to be set on the ring gauge for comparison purposes. On the right are two finished headspace gauges designed for use in the Springfield

the two-inch grade similar to the Starrett I am now using. Either the #2 or the #213 would be satisfactory for this work. The only difference between these two instruments is that the #213 is graduated with the vernier on the sleeve, while the #2 lacks this useful and practical scale. The two-inch micrometer will check measurements from one inch to two inches, and with a very practical attachment bearing the Starrett number of 212, this tool can instantly be converted to handle measurements from zero to one inch. It can therefore be used to replace the standard one-inch micrometer and for handloading is much to be preferred, particularly since the two-inch capacity will permit the overall measurement of any handgun cartridge and the measurement of case lengths, outside diameters, and such things.

The attachment is an additional spindle which slips over the anvil, thus extending it exactly one

inch. It is properly fitted with a device to permit it to be maintained at a constant zero, and to be changed from a micrometer measuring from zero to one inch to an additional tool measuring from one inch to two inches in a matter of a few seconds. With the instrument comes a standard test gauge, a hardened and carefully ground steel disc one inch in diameter and one-fourth inch thick.



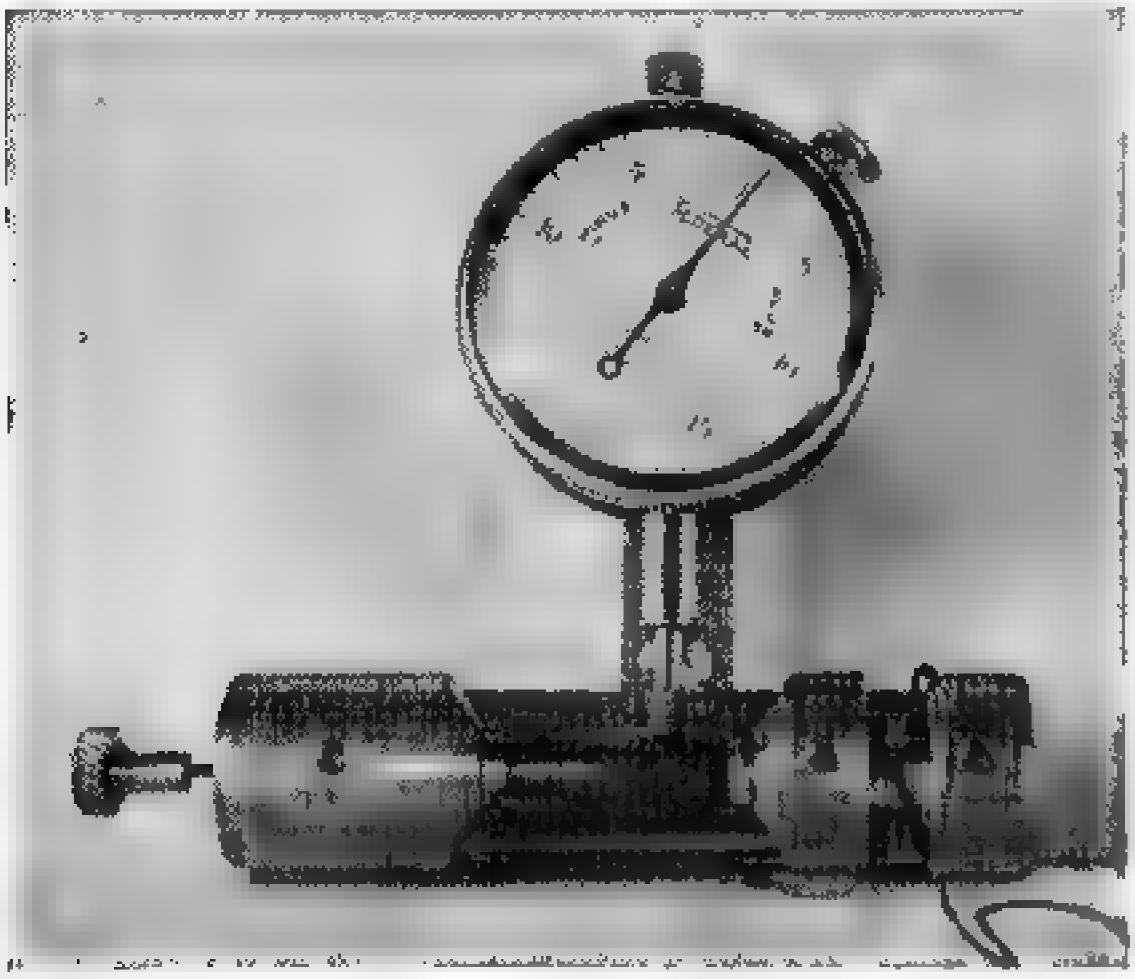
Wilson gauges. Top three units: A Wilson throat gauge. The handle portion at the top is screwed into the gauge proper at the bottom, the sleeve at the center is then inserted in the chamber of a Springfield rifle with the bolt removed. The throat gauge is then slid into the sleeve with the sleeve pressed up against the shoulder taper. The ground forward end carefully fits this taper. The gauge is then pressed into the chamber snugly and the forward portion of the section shown at the bottom is designed to fit into the throat of the rifling, the front section being of land diameter. The wear on the throat is shown in the flat or cut-off portion of the sleeve. If there is no wear, the circumferential line shown at the bottom portion next to screw thread should coincide with the extreme end of the sleeve. If this goes 1/8 inch beyond the end, it indicates that there is that amount of wear in the throat, and the handloader should seat his bullets out to a greater overall length equal to the amount shown on the gauge to eliminate the jump of the bullet into the rifling. Bottom: Two Wilson headspace gauges—maximum and minimum—designed for use in the Springfield

A somewhat different arrangement is used by Brown & Sharpe on their micrometer calipers #45 and #45RS. This has an adjustable anvil in place of the anvil attachment used by Starrett. It comes with a one-inch standard disc similar to the typical Starrett construction to be used in zeroing the instrument when a change in adjustment is made. In this type of tool the anvil is clamped in position with a small thumb nut, and when fully extended inside the frame, measurements run from one inch to two inches. When this anvil is withdrawn to proper position, which is checked each time with the one-inch standard gauge and locked there, readings can be made from one inch to two inches Since both of these types of construction are entirely satisfactory, the author does not care to go into the merits of the individual designs. Both are quickly adjusted, and when adjusted are equally accurate. The Starrett type uses a detachable anvil, while the Brown & Sharpe is all one unit. For the careless man who is always misplacing things, perhaps the latter make would be better. I have used one for two years and find that it maintains its accuracy well.

A recent development is a modification of the customary vernier system of reading one ten-thousandths of an inch on a direct thimble. This new micrometer caliper, designed by Brown & Sharpe under their #24 and #24RS (RS following the number on all micrometer calipers indicates "ratchet stop"), is for the chap who has trouble reading a vernier. This is really the answer, as the divisions beyond thousandths are read from an additional thimble and sleeve on the frame just below

The headspace gauge made by Wilson to measure the headspace of a Springfield rifle, from the fired cartridge case. The gauge is previously set (usually by Wilson) to accommodate the minimum standard headspace gauge. The case is then dropped into the chamber and the plug gently screwed down until it contacts the shell. Direct reading is made on the dial. Each one of those large graduations represents .001 inch. It is a simple matter to split this into quarters. In use, the average of four or five shells should be taken to determine headspace, as some brass shrinks slightly

the main thimble. It is sturdily constructed with no gears or other intricate mechanisms to get out of order. In using this instrument, one sets the main thimble exactly as in using the customary form of micrometer. To the reading of the main



L. E. Wilson of Cashmere made up, for his own use, a bullet spinner using equipment available in his machine shop. A standard dial gauge is used, the bullet being held in two ball-bearing chucks. A string is wrapped tightly around the grooved portion, as shown, and the bullets are spun back and forth rapidly or slowly. The amount that a bullet is out of concentricity is indicated directly on the dial. The above bullet measured by the author is evidently .00075 out. This is by no means serious and falls within the so-called perfect selection. Many bullets will run as much as .010 out, and these should be rejected for fine match shooting

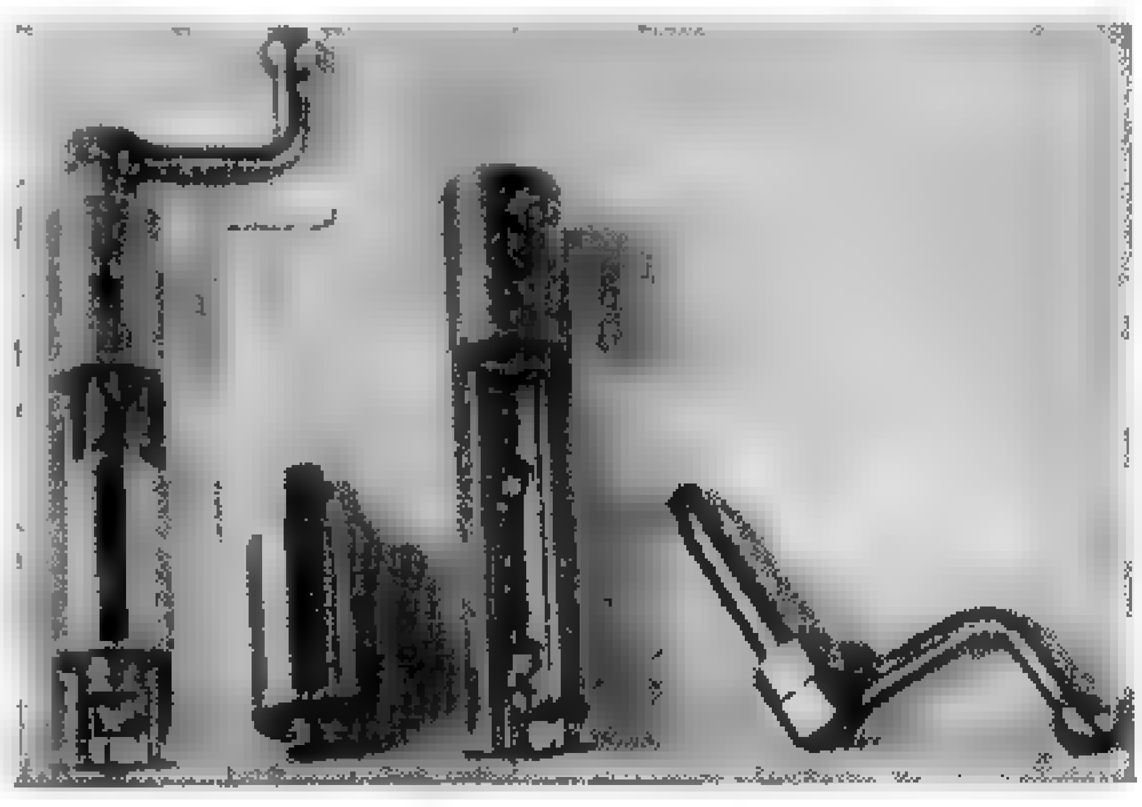
barrel and thimble in thousandths of an inch, simply add the reading of the small auxiliary thimble, each graduation of which indicates one ten-thousandth. The small thimble turns independently of the main thimble and does not affect spindle movement. This feature is exclusive with Brown & Sharpe. The graduations are large, and with extremely careful measuring, a ten-thousandth of an inch could be split into quarters (.000025), although there is no application in handloading for such fine measurements.

Another very important tool for the man who prefers to enlarge his equipment is the Starrett #700 Inside Micrometer Caliper, or the similar Brown & Sharpe #250, suitable for taking internal measurements of case necks, barrel bores, cylinders and chambers and case necks where the end being measured has a flush surface. This instrument is similar to a standard micrometer caliper, except that the reading is of course controlled through two extending noses of the tool. It will measure inside diameters from .20 inch up to one inch.

In April 1937, some manufacturer who prefers not to use his name on his product, brought out a micrometer which is worth while for any handloader to investigate. This unit looks like the conventional half-inch micrometer reading in thousandths, and is made of cast zinc or some similar non-ferrous metal. Parts are, of course, pressure die castings. The anvil is of soft steel, as is the spindle. Probably both are cold-rolled. The interesting part of this unit is that the entire "mike" sells for *only nineteen cents!* Naturally one can expect very little for this money, and probably many of these micrometers are junk, but they are being sold by mail-order houses such as Sears, Roebuck & Company and Montgomery Ward, as well as by many chain automotive supply houses.

The author purchased a couple of these and found them to be remarkably accurate for the price. They can be made to read accurately, but of course wear will spoil them, as there is no provision for wear take-up as in the better-grade units. This low price means that any handloader can acquire one or more of these to last until he can afford to acquire better instruments.

Caliper Squares. A caliper square is also a very useful accessory for the man who does not have a

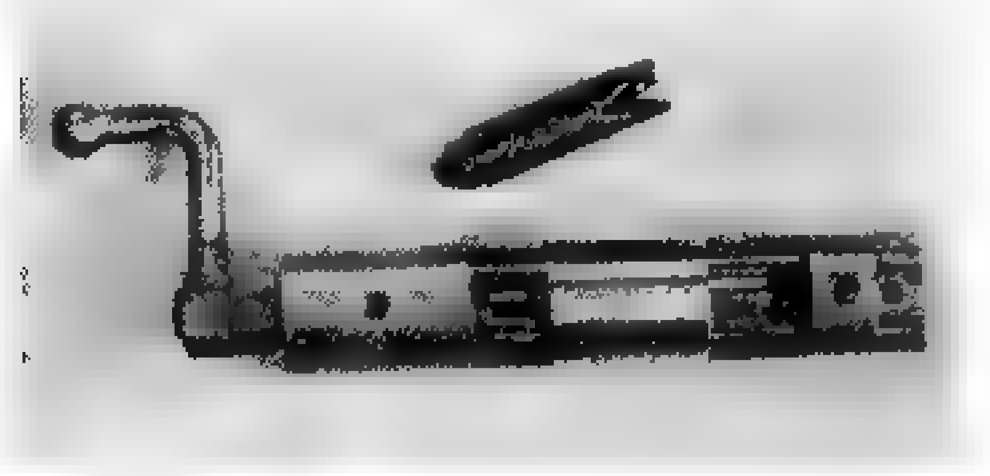


Wilson cartridge-case trimmers. Left: the non-adjustable type designed for the .30/06. This trimmer not only shortens the cartridge case to the proper length each time, but also slightly chamfers the inside of the case neck. On the right are the various components of this reamer. Note "V-rest" principle on which the carefully ground shell holder is properly centered on round raceways

large-capacity micrometer. One of the inexpensive types is the Starrett #426, Size B, obtainable through any tool store. This has a capacity of 4 inches and is excellent for measuring either outside or inside diameter, the latter as small as .25. Brown & Sharpe list this tool as their #960. Many

handloaders have been using a tool of this nature over a long period of time and have found it to be highly satisfactory. It consists chiefly of a movable jaw on a small square which can be adjusted to any measurement by means of a screw. One side is graduated into sixty-fourths of an inch while the other side reads to hundredths. The use of a scale like this to check accurate readings requires a small magnifying glass, but this need not be a complicated instrument. One magnifying approximately three or four times will show up the hundredths scale quite effectively.

In checking the overall length of a cartridge, one can readily determine the seating depth of a bullet.



Wilson's latest adjustable trimmer, in which one unit, equipped with proper shell holders, will handle all cases from the .22 Hornet to the .375 H. & H. Magnum. This trimmer, because of the adjustable feature handling all calibers, does not chamfer the inside of the case neck and turns up a very slight burr both inside and out. The auxiliary burr-removing tool is supplied with this and is capable of handling all calibers. It is very simple to use

This is of extreme importance if precision results are to be obtained. In the loading tabulations of this book, the seating depth of most bullets is clearly given, this figure being determined by the actual research of ballistic laboratories. To duplicate these figures, the handloader should use his particular make and lot of bullets and measure their length by means of a micrometer caliper. He may then measure the length of the cartridge case by means of a caliper square or other instrument, add to this the length of the bullet, and subtract the specified seating depth, which will give the proper overall length. His caliper square may then be set to that overall length and used to check the cartridges during the setting-up of the tool.

A de luxe version of this caliper square is the Starrett #122 or the Brown & Sharpe #57, which is almost identical with it, but equipped with a vernier. These scales are graduated on one side into sixty-fourths of an inch while the other side reads to hundredths. It is also possible to substitute metric measure for the fractions. The vernier on the movable jaw enables accurate readings to be made to .001 inch, thus eliminating the necessity for the estimation of any desired figure. It, of course, costs considerably more than the other tool, but for the man who wants the best and the most practical, the investment is well worth while.

Another useful and inexpensive tool, and one which the writer has used to great advantage for many years, is the Brown & Sharpe 2-inch Bevel-Edge Scale. This is a small instrument with a tiny leather case and is graduated on one beveled edge to sixty-fourths and on the other to hundredths of an inch. Under magnification of approximately 3 × or 4 × this scale can be used to read to half-thousandths (.0005) of an inch. It has a multitude of uses, and the author has had his so many years that he had forgotten that the initial cost was only 65 cents.

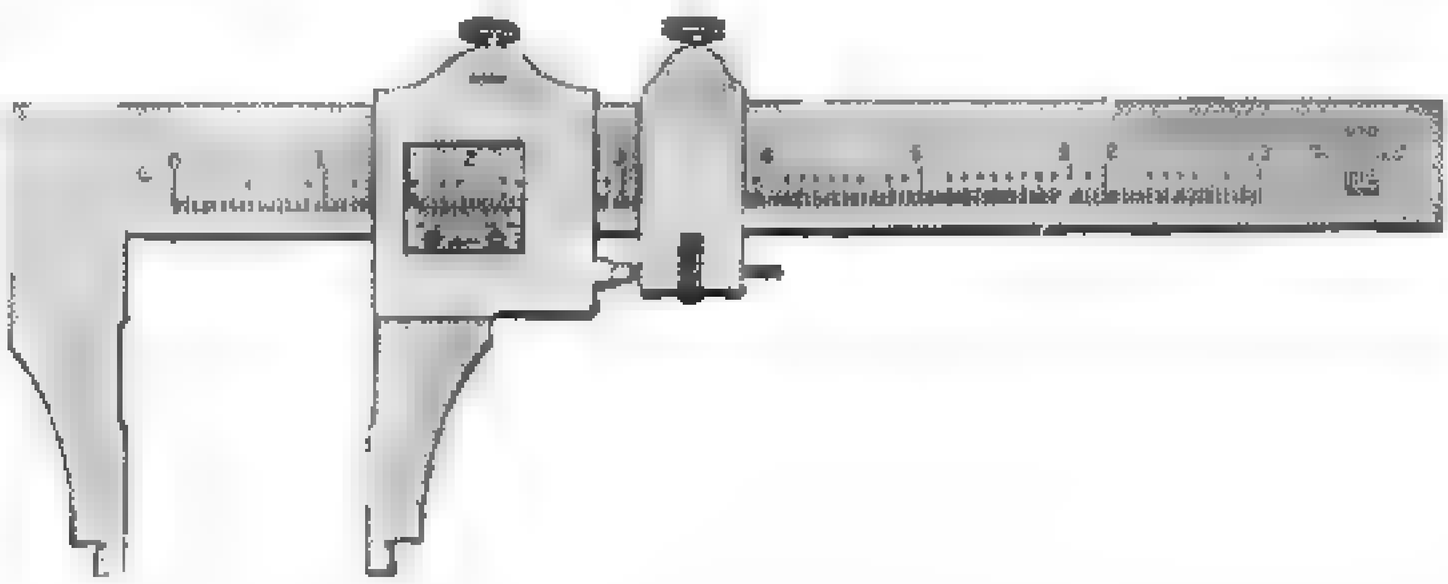
L. E. Wilson, toolmaker, of 104 South Division Street, Cashmere, Washington, makes a number of tools, dies and gauges designed especially for the handloading fan. Mr. Wilson is himself a shooter; a man who is a thorough gun bug and handloading experimenter, and he has a shop equipment and skill suitable for the manufacture of precision tools. Practically all of his shooting records have been established with rifles barreled and chambered by himself and with loads assembled with the handloading tools, dies and gauges which he has both designed and manufactured. Mr. Wilson has made a number of these tools for me in past years. I have found him both willing and anxious to cooperate. Because of his shooting experience he knows exactly what the handloading fan wants.

Cartridge Case Trimmers. It is a recognized fact that a cartridge case will stretch upon firing. No way has yet been found to prevent this, and the only answer has been to trim the case. There has been, however, no definite way to trim this brass properly or to gauge its length to prevent over-trimming. Previously handloading fans have been compelled to dress down their case mouths with a fine file, trying these in the gun or gauging them beside a new and unfired cartridge case in an effort to guess the length. Accordingly, authorities in writing on this subject have deliberately steered clear of descriptions and have merely stated positively that "the repeatedly fired cartridge case should be trimmed to return it to normal." They have left it up to the fan himself to figure out the system.

There has long been a need for a satisfactory trimmer capable of keeping the cartridge case in proper condition. The unfortunate part of this problem is that every caliber of case requires a different dimension of trimmer, and accordingly

this problem is greatly magnified. Mr. Wilson has designed a trimmer which at this writing is available for a number of cartridges and is so designed that it can readily be adapted to other calibers at a nominal expense.

The author has experimented with a number of sample models of this tool, but the final type which has been placed on the market appears to embrace all the features essential for best performance. It is certainly all that one can ask for, both in method of operation and in precision of the work; for cases must always be trimmed with care and great precision or the value of the handloads will be lost. end. The cartridge case in its holder is placed in the guides in position and the reamer inserted into the bushing where it contacts the case neck, whereupon the crank is operated. The easiest method of handling this is to palm the ball and spin gently. It may be operated at a speed satisfactory to the operator and cuts down the surplus metal on the case mouth. It takes merely a few seconds, and the stop collar causes the reamer to stop cutting when the case is shortened to the necessary standard. With this new instrument I took a sealed carton of 50 .30/06 commercial primed shells, ran them through the reamer, and found



A very useful accessory for the precision handloader: A caliper square equipped with vernier. Such an instrument can be obtained without vernier, of course, at less money. These are manufactured by both Brown & Sharpe and the L. S. Starrett Company, and other toolmakers. The above tool is a Brown & Sharpe. It has a capacity, depending on size, of from a few inches up to more than a foot, and with the vernier can be used to read lengths in .001 inch. When used for inside measurements, the minimum reading is .25, and to the scale reading, ¼ inch must be added to get proper inside diameter

This trimmer as designed will handle either new factory cases or those which have been fired and left unresized or fired and resized. Operation is exceptionally simple.

To use this trimmer, one simply slips an empty shell into a cylindrical steel holder one inch in diameter and approximately 1½ inches long. This holder is a carefully ground steel rod having a hole through it reamed to the exact taper of the cartridge-case body. The entire neck projects through, as does a small portion of the head. The case is pressed into this holder with the fingers, and the steel block is then dropped into the block holder, in which the guides are two round steel rods, thereby centering it through the famous vee-block principle.

At one end of this guide or track is a carefully positioned block which contacts the head of the cartridge case, acting as a stop. At the other end is a cylindrical guide or bushing through which the cutting reamer operates. The entire unit may be held in the hand, clamped in a vise, or attached to a bench with screws. Bench attachment is to be preferred. The reamer is equipped with a stop collar and operating crank having a round ball approximately 20 which were not touched by the cutter. The remainder were trimmed and chamfered in varying degrees, but before the batch had been completed, there was quite an accumulation of brass chips. The entire 50 shells were run through in approximately two minutes.

When Wilson first brought this trimmer out, it had a two-way reamer designed to chamfer cases in the same operation. The original models were made only for the .30/06, and thus could be so constructed. But the demand for a trimmer forced several additional calibers to the front, and the reamer was ground so that it becomes nothing more than an end mill, trimming off the brass flush and square. Thus the same tool can be used for .22 Hornet, .220 Swift, .25 Roberts, .257 Roberts, .250/3000, 7 mm., .270 Winchester; .30/30, .303 Savage, .300 Savage, .30/40 Krag, .30/06 and .300 Magnum. Other calibers are being added, so that by the time this appears in print, most of the popular rifle sizes will be available.

How is it possible to adapt this tool? The case-head stop has a screw adjustment, and the base is drilled for six stop positions, covering all case lengths from the Hornet to the .300 H. & H. Mag-

num. Therefore the stop is moved to the approximate position, the fine adjustment obtained with the screw, and the proper shell holder used. To trim to different calibers, one need purchase only additional shell holders. A length gauge would be extremely useful, however, for setting up,

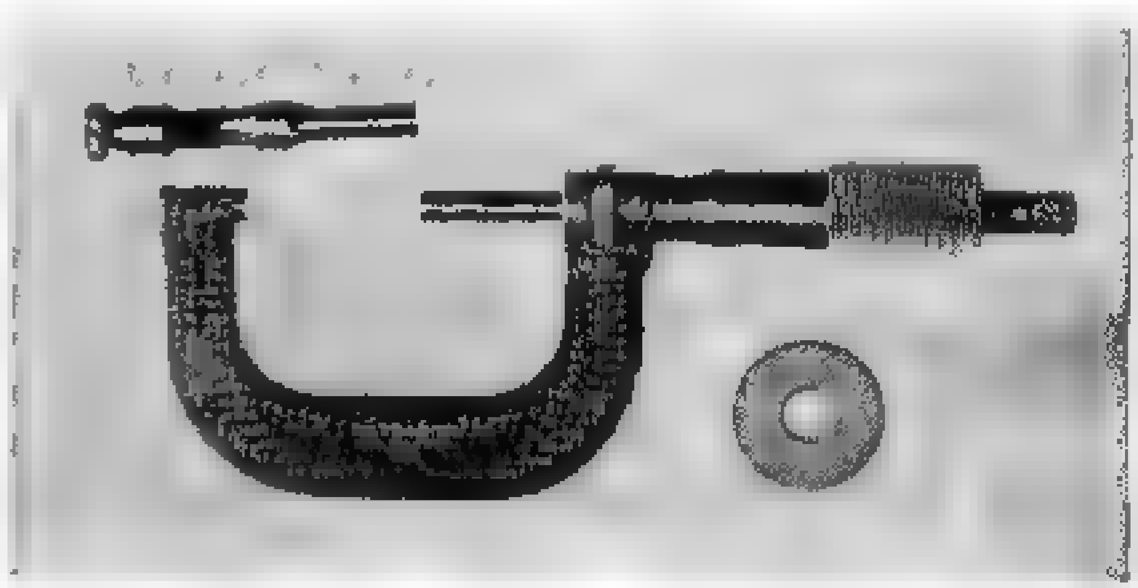
Brown & Sharpe 2-inch Micrometer with Adjustable Anvil. This is an extremely practical tool and serves the purpose of two separate instruments. It has a capacity ranging from zero to one inch, as illustrated above, and when the anvil is slid back to proper position, the capacity is increased from one inch to two inches. A standard which is sent with the instrument is used to check the adjustment

and the handloader will do well to keep a trimmed case in his kit as a master gauge, properly inscribed on its side by means of some scratching device. Naturally the trimming operation leaves a slight burr, both inside and outside the neck. Wilson supplies with the trimmer a special burring tool which removes the inside burr and gently reams the neck, while at the same time the opposite end will straddle the case neck to remove the outside wire edge.

Headspace Gauges. It is indeed unfortunate that headspace gauges are not available to handloaders in the assortment of calibers necessary to satisfy the diversified list of shooters. They are precision instruments—a bit out of the reach of many of us. These gauges can be obtained by users of the excellent .30/06 rifle, and the same gauges for the .30/06 can be used interchangeably with equal precision in the .270 Winchester caliber, since that cartridge is the .30/06 necked to .27 caliber with an identical angle of neck taper. Headspace gauges can be obtained in this caliber by the members of the National Rifle Association through the office of the Director of Civilian Marksmanship, together with a few other very special instruments; but the price is high. These gauges are not listed in the regular DCM price list, and it would be best for the prospective purchaser to write direct to the office of the Director of Civilian Marksmanship, War Department, Washington, D. C., for prices and ordering instructions.

Generally speaking, the Ordnance Department uses four different types of headspace gauges for the .30/06 cartridge. Headspace tolerances are, of course, in this caliber, *the distance between the face of the closed breech bolt and the mid-point of the forward taper of the shoulder, just behind the neck.* Two definite measurements are used—a maximum and a minimum—the former being 1.946 inches and the latter 1.940 inches. These gauges look like a hardened and ground steel dummy cartridge case, less the neck, and with the center or "waist" of the shell body cut out merely for relief. When a rifle leaves the armory—and incidentally this also applies to the commercial manufacturing plants and the better class of gunsmiths who fit barrels—the chamber must accept the minimum-length gauge but must not handle the maximum. Ordinarily, with a tolerance of .006 inch, the average rifle hits about half-way between this, or about 1.9435.

In addition the Ordnance Department uses a "field gauge" or similar type which measures 1.950 inches. This gauge is used by Ordnance officers to



Another useful design is the Starrett Adjustable Anvil, designed for micrometers having a normal capacity of from 1 inch to 2 inches. With this type of design a standard 2-inch micrometer which can normally be used for measurements only of 1 inch to 2 inches is converted by means of a separate anvil, attached in an instant by means of a single set screw. This fits over the regular anvil and once adjusted for zero may be used for several change-overs without further adjustment. An extremely useful accessory

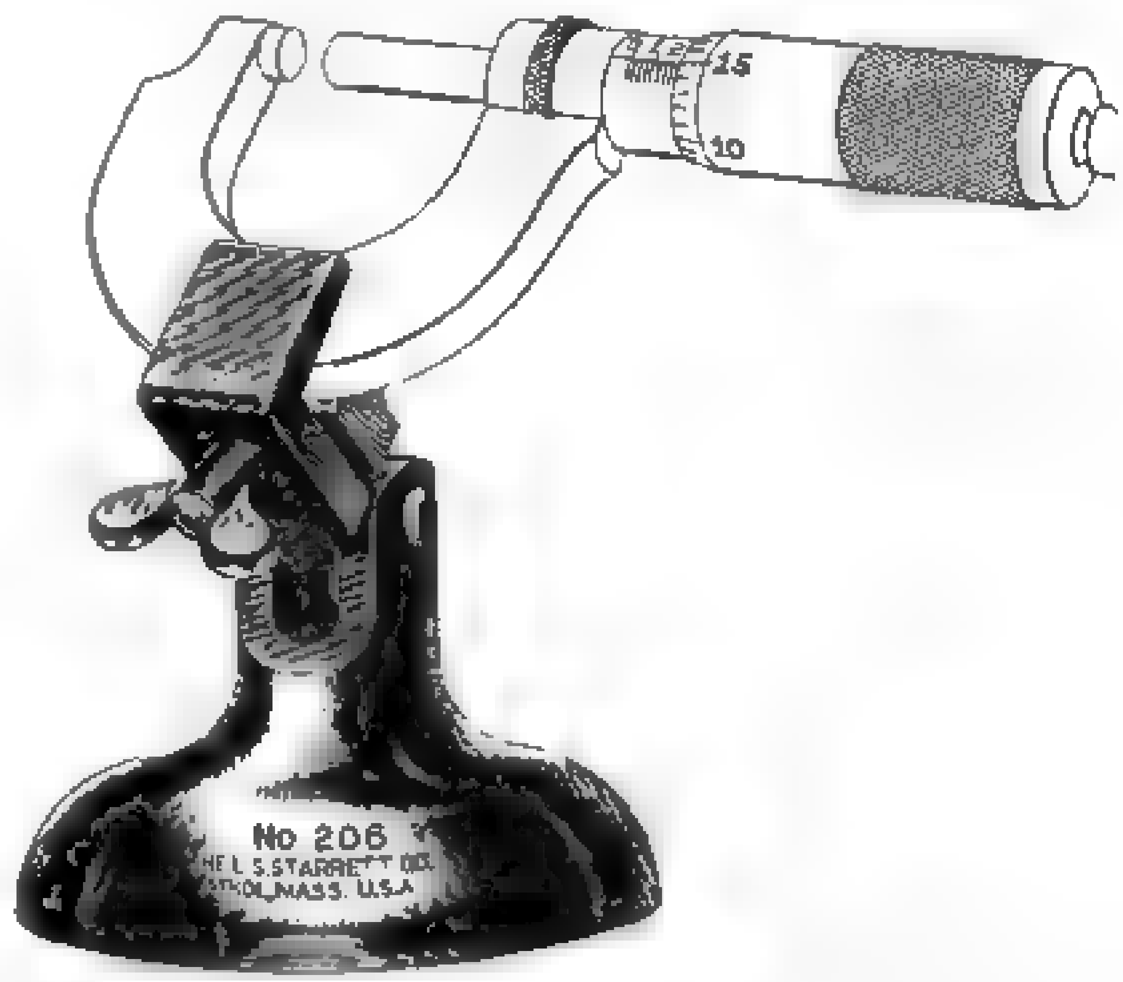
check the rifles in service, particularly to find rifles which are irregular through the interchanging of bolts by enlisted men to get "a smoother-running action." If any rifle accepts this "no-go" gauge, it is immediately withdrawn from service and shipped to Springfield Armory or some similar

supply and service depot to have the headspace corrected. This correcting CANNOT BE DONE IN THE FIELD, even by trained Ordnance men.

There is still a fourth type of gauge—a micrometer type used only at Springfield Armory and other large manufacturing plants for a more detailed check. This appears like a neckless .30/06 case, but is split at the center, and the forward half screws over a spindle, much like the spindle of ordinary micrometer calipers, or "mikes" as the workman calls them. The easiest way to visualize this gauge is to visualize a mike without the horseshoe arm, and with a movable rotating spindle-nose, shaped like the shoulder of the chamber. This gauge is rotated to position, inserted in the chamber in much the same way as the fixed type, and the bolt closed. If the bolt closes easily, the gauge is withdrawn, opened a few more ten-thousandths, and given further trial. When the bolt closes tightly but without undue force, the gauge is removed and "read" from the micrometric scale, much the same as reading micrometer calipers, except that the gauge functions through a very narrow range of perhaps a couple of tenths of an inch. This gauge proves useful as a final check, and is widely used in Match Springfields to get the headspace at about 1.9435 inches. The gauge is delicate because of its fine screw threads, as the latter can be ruined through an oversize setting and an application of the powerful leverage of the Springfield camming lugs in closing the bolt. There is much less danger of breakage in the use of the "fixed" type; hence this is far more common in the arms plants.

How is this headspace adjusted? Roughly chambered barrels are fitted in position on the action and then chambered the remainder of the way mostly by hand with special finishing reamers. Various gauges are tried, beginning with the minimum. After the chamber accepts that, the progress is slow, as but .0035 inch needs to be removed to complete the job, and twice that amount will spoil it. In the case of a rifle with too much headspace, the barrel is removed from the action, the shoulder butting against the forward ring of the receiver turned off the width of *a single thread*, and the barrel replaced in the action, but turned one complete revolution more than its original position. It is not possible "to take up" headspace by tightening up the barrel—if it is already tight—because that would twist the front sight to one side, and a half turn would place the sight on the bottom of the barrel. The newly fitted barrel is then rechambered a bit deeper, the headspace gauges being used to control the depth of the cut.

Several gunsmiths have recently placed on the market headspace gauges of the fixed type for the .30/06 and other calibers. I recently acquired a pair of these from the same Wilson previously mentioned and find them to be superior to my Ordnance Department gauges, especially at the most delicate part of the gauge—the head. Illustrations of one of these gauges compared with an Ordnance Field Gauge clearly show the superiority of the Wilson gauge. These instruments, of



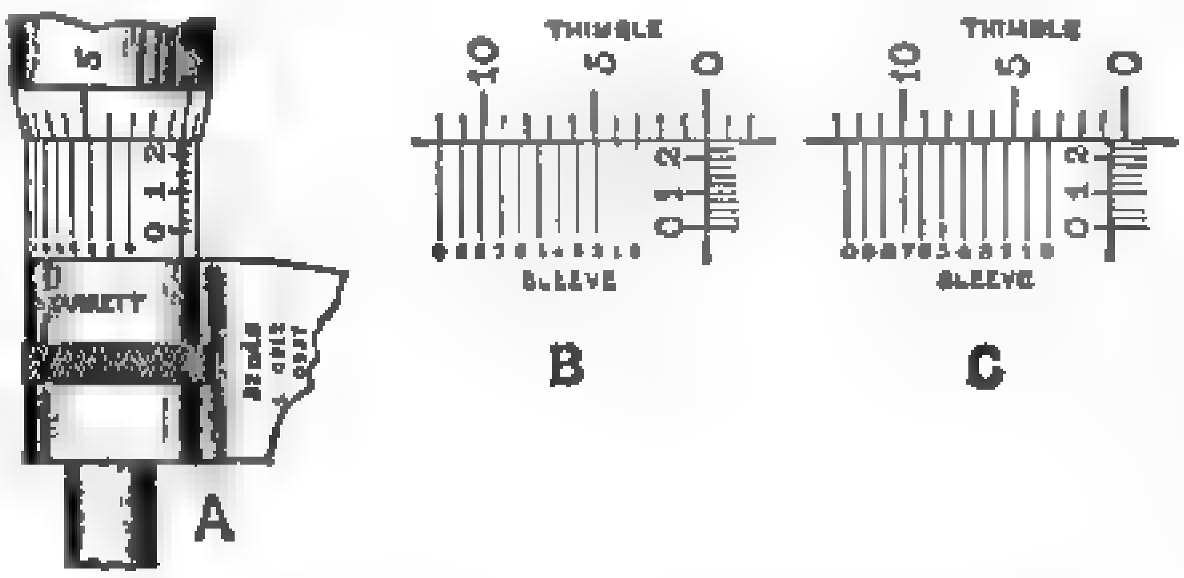
A micrometer stand is a very useful, although not absolutely necessary, item. This can be adjusted to hold a micrometer at any angle, thus allowing both hands for the work. Bullet diameters may be quickly checked by using the right hand to operate the spindle and the left hand to hold bullets

course, must necessarily be ground to shape and then hardened, the final fitting being accomplished in a universal grinder to remove any "scale" or warpage. Wilson has eliminated sharp corners in the bottom of his extractor groove cut, a noteworthy improvement. Any metallurgist will testify that even a strong steel forging will fracture in a sharp angle under stress, regardless of the "reinforcement of construction." Springfield Armory gauges frequently have the entire rim chipped off through dropping or careless handling in a tool kit.

The latest report was that Ordnance Department gauges of the fixed type could be purchased for \$4.50 each (\$9.00 the pair) plus 10 per cent tax, plus 20 cents packing charge, plus postage. Wilson sells his gauges for \$4.00 each, postpaid, and they are highly useful to those who desire to check assorted .30/06 rifles at regular intervals.

Early in April 1935 Mr. Wilson brought out a gauge that should be in every handloader's kit—especially that of the rifleman who loads for the

.30/06 and .270. I have been using one of these for some time, and am so enthusiastic over its value that I use it to check every .30/06 cartridge I load, and all resized cases before loading. This gauge is actually a .30/06 semi-chamber, full shell length, carefully reamed into a block of what appears to be finely outside-ground cold rolled steel. In making this gauge, the rod of steel is first reamed so that a 1.946 headspace gauge will drop



A handloader should always obtain micrometers that are equipped with a vernier for reading bullet diameters in ten-thousandths of an inch. The above sketch, lent through the courtesy of the L. S. Starrett Company, shows how the ten-thousandths readings are obtained. The vernier consists of ten divisions on the adjusting sleeve which occupy the same space as nine divisions on the thimble. The difference between the width of one of the ten spaces on the sleeve and one of the nine spaces on the thimble is, therefore, 1/10 of a space on the thimble. In the above, the third line from zero coincides with the first line on the sleeve. The next two lines on the thimble and sleeve do not coincide by 1/10 of a space on the thimble; the next two, marked 5 and 2, are 2/10 apart, and so on. In opening the tool by turning the thimble to the left, each space on the thimble represents an opening of .001 inch. If, therefore, the thimble is turned so that the lines marked 5 and 2 coincide, the caliper will be opened 2/10 of one one-thousandth or two ten-thousandths. Turning the thimble further until the line 10 coincides with the line 7 on the sleeve, as in the above Sketch C, the caliper has been opened to seven ten-thousandths and the reading of the tool as above set is .2507. To read a ten-thousandths caliper, first note the thousandths as in an ordinary caliper and then observe the line on the sleeve which coincides with a line on the thimble. If it is the second line marked 1, add one ten-thousandth, if the third line marked 2, add two ten-thousandths, and so forth

in flush. The head end then has one-half of its surface milled off to a depth of .006, thus giving a maximum and a minimum. If a cartridge is dropped into this gauge and projects beyond the highest half, it has too great headspace and the bolt of the gun cannot be closed without compressing the brass. If it drops into the chamber or the gauge *below* the step cut, it measures *less* than 1.940, and therefore is dangerous to shoot—*as dangerous as shooting a normal cartridge in a rifle having too great headspace.* If cases or cartridges stop between the two steps, they are O.K.

This gauge is trimmed to a length of 2.494 inches before any milling is done, thus matching the maximum permissible length of the cartridge cases when used with the 1.946 or maximum gauge. This end is similarly milled to give a minimum neck length. The gauge sells for only $3.25 and should be used constantly by handloaders. With it I found that a negligible amount of effort was required in either full-length or neck-only resizing with both of my two .30/06 loading sets to increase the headspace by .025 inch—something I previously did not know. Furthermore, I used it to check some handloads of fellow shooters and found that they had also over-resized, to create excessive headspace.

Headspace is certainly an important and ever-present problem before the handloading fan, particularly if he uses rimless cases. The rimmed type does not depend on the shoulder of the cartridge to check the forward movement of the case, and if a rim is in fair shape, unbattered and clean, there need be little worry here from a safety standpoint. It then resolves itself into a matter of an undersize case, which gives poor accuracy.

Throat Gauge. Another pair of Wilson developments are his .30/06 throat gauge and his cartridge-case micrometer for .30/06 and .270 Winchester cases. The throat gauge is unique in appearance and operation. It is composed of three pieces, including the handle section, and fits compactly into a kit six inches long. The illustration of this throat gauge clearly indicates its operation. A great many of these throat gauges have been sold to clubs and to Marine Corps rifle teams who have a lot of arms to take care of. This instrument is essentially a club proposition, as the individual rifleman would have very little need for it. It tells you when you must go in for a new barrel because of wear on the leade or throat of the rifling.

Essentially it consists of a throat-gauge rod with pilot and guide. The gauge portion is a carefully ground tool-steel rod with a pilot end in land diameter which enters the rifling quite readily. Back of this the rod is ground according to standard specifications of the throat. In use the pilot or sleeve is inserted into the chamber with the bolt removed. The handle section is screwed to the end of the rod merely to lengthen it out and facilitate handling. This is then gently pushed through the sleeve until it can enter no farther. The pilot end rides in on top of the lands and the remainder continues until the ground taper strikes the rifling throat. A register mark on the rod will coincide with the far end of the sleeve if the Springfield rifle

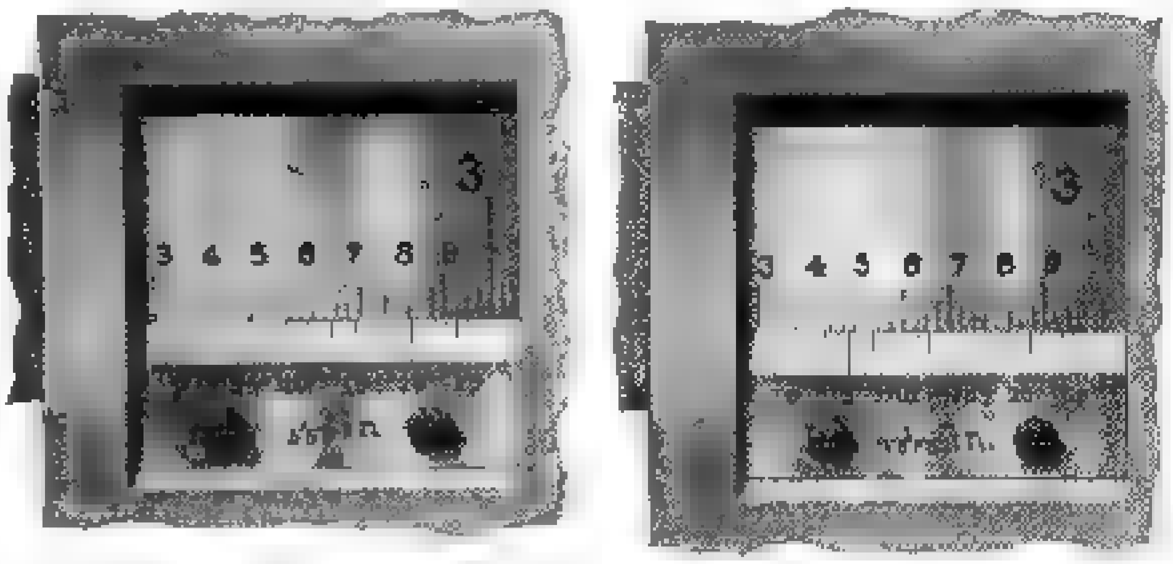
is new and in perfect condition. A section of approximately 3/8 inch is cut out of the top of this sleeve so that one can notice the amount of wear which will be indicated by the distance beyond the end of the sleeve that the throat gauge can be inserted.

Using one of these instruments not long ago, the author tested a number of different Springfield target rifles and found that the wear on the leade of the three particular target rifles showed 1/16 to 3/16 inch on the throat gauge. This may have been a matter of but a few thousandths on the leade, but in a standard length of cartridge the bullet would have to jump that distance before striking the rifling. The answer, of course, would be that with a slightly worn barrel, it would be necessary to seat the bullets farther out of the case neck. In many instances this makes the cartridges too long to function through the magazine. This gauge will not indicate the erosion wear insofar as diameter is concerned, as the gauge is ground to .308 inch—equivalent to groove diameter. It is interesting to note that new Winchester .30/06 barrels which we tested with this instrument showed that they are throated about 1/32 inch tighter than the Springfield standard. As a club or team instrument this is an excellent device, but the price of $10.00 is somewhat high for the individual.

Cartridge-Case Micrometer. The cartridge-case micrometer is another useful thing for a club or for the individual shooting his rifles a great deal and having more than one gun in .30/06 or .270 Winchester caliber. This micrometer will measure the headspace of a rifle *as indicated by a fired cartridge case.* If standard headspace gauges are used, it may be zeroed as desired by the user. The author recommends that it be zeroed at 1.940—the minimum permissible headspace of the .30/06 cartridge. The tolerance in this or .270 Winchester caliber is but six one-thousandths—from 1.940 to 1.946.

To use the gauge you unscrew the micrometer plug in the head and drop in your fired or unfired case. It is best, of course, if checking the headspace of the rifle, to use a fired and one resized case; and if several are on hand, all should be measured to take care of possible individual variations in the brass. A loaded cartridge can be measured, as the bullet will merely protrude through the opposite end of the gauge. A ring in the body of the "mike" stops the case at the proper point on the shoulder. The instrument is set by Wilson with a 1.940 headspace gauge unless otherwise ordered.

With a case dropped into the gauge, return the plug to the open end and screw it down by means of the thumb nut, using it, of course, with the care accorded any micrometer. A zero mark on the plug of the gauge will coincide with a register mark on the rim of the gauge body if the cartridge case has been fired in a minimum headspace



The above illustrations, lent through courtesy of Brown & Sharpe, show the use of a vernier on a standard caliper for reading in 1/1000 inch. The illustration shows the vernier used with a scale which is graduated into fortieths of an inch or .025 inch. The vernier has 25 divisions which are numbered every 5th division, and which equal, in extreme length, 24 divisions on the scale, or 24 x 1/40" = 24 x .025" = .600". Thus, one division on the vernier equals 1/25 of .600" = .024". Therefore, the difference between a division on the vernier and a division on the scale = .025" − .024" = .001". When the reading is exact, with respect to the number of fortieths of an inch, the zero on the vernier coincides with a graduation on the scale—either inch, tenth or fortieth, as the case may be. This leaves a space between lines on the scale and the 1, 2, 3, 4, 5, 6, etc., lines on the vernier of .001", .002", .003", .004", .005", .006", etc., respectively, the difference increasing .001" at each vernier division in numerical order until, at the 25th graduation, the lines again coincide (see upper cut).

Thus, when the 1st, 2nd or 3rd, etc., line on the vernier coincides with a line on the scale, the zero on the vernier has moved 1, 2, or 3, etc., thousandths of an inch past the previous fortieth graduation to bring these lines together. To read—Note the inches, tenths and fortieths of an inch that the zero on the vernier has moved from the zero on the scale, and to this reading add the number of thousandths indicated by the line on the vernier that coincides with a line on the scale. Example: The left hand cut shows the zero graduation on the vernier coinciding with a fortieth graduation on the scale (the second fortieth beyond an even tenth graduation). This indicates that the reading is exact with respect to the fortieths of an inch. The reading therefore equals 2.000" + .300" + .050" = 2.350". The right hand cut, however, shows the 18th vernier graduation coinciding with a line on the scale. This, then, equals 2.000" + .300" + .050" + .018" = 2.368". Verniers with 25 divisions are used, for English measure, on all Brown & Sharpe verniers with the exceptions of Thread-Tool Verniers #576 and Gear-Tooth Verniers #580, 20 to 2 diameter pitch, on which verniers with 20 divisions are used

rifle. Each graduation on the plug equals .001 inch, and they are spaced widely enough to permit of ready estimation of one-half thousandths. To read the "mike" one merely adds the number of points between the register mark on the case body and the zero on the plug, and adds them to the

minimum standard at which the gauge is set—1.940. The average Springfield rifle, if in perfect condition and new, will measure approximately 1.943. A couple of thousandths either way is all right. If the rifle has excessive headspace, this micrometer will show it quickly and accurately, provided, of course, that the case has been fired with a full-charge load to expand it properly. This gauge is a precision instrument and also sells for $7.50—originally priced at $10.

With this case gauge I tested a certain "custom-built" rifle belonging to a friend not long ago. He was using standard commercial ammunition in a .30/06 hunting load, and the first shot locked the gun solid. He brought it to me for examination, and after a great deal of work I finally opened the bolt and withdrew the fired case. I tried the Standard 1.950—"no-go"—gauge and found that this rifle readily accepted it, which confirmed my suspicion that headspace was excessive. That same case, which is still in my possession—the rifle has long since gone back to the maker—measured in Wilson's gauge 1.963 inches, or 17/1000 more than the maximum permissible headspace! An extremely dangerous job of chambering had been put into that barrel, and the shooter was very lucky not to have wrecked the gun or himself or both. A gauge like this belonging to a club—or to the individual who uses many rifles in the same caliber—will prove of extreme value and be a worth-while investment. It may also be used to check the "headspace" of loaded cartridges to determine the proper setting of the resizing dies.

Bullet Spinner. An interesting tool about which there is much comment in recent years is the bullet spinner. The first of these was designed by the late Lawrence Westnitzer of San Jose, California, who died in 1946. Manufacture was resumed by Cox & Sprague of 631 North 13th Street, San Jose. Designed for .30-caliber bullets, it would not work well with smaller sizes such as .22 caliber. The idea of a bullet spinner is to eliminate, so far as possible, bullets and cartridges which are not perfectly true—in other words, bullets whose axes are not perfectly parallel to the sides of that portion contacting the barrel, or cartridges which may have perfect bullets seated somewhat out of line to give more or less of the same effect.

Wesnitzer's bullet spinner operates on a very simple mechanical principle. It is designed with a cast aluminum base machined with two large holes for attaching to a bench. Two small carefully ground steel rollers of a diameter of 1.125 inches are supported upon hardened shafts carefully ground so that there is no noticeable play. One of these is driven by a two-inch knurled wheel. The bullet to be examined is laid in the groove between these two rollers, and a small swinging arm equipped with a carefully ground one-inch wheel is dropped down to form a third point of contact. The large knurled knob on the driving wheel is then rotated slowly and the point of the bullet watched closely during this operation. The amount it wobbles indicates the degree to which it is not concentric.

In using this instrument Mr. Wesnitzer recommends that a shaded desk lamp be placed in such a position that it will cast the shadow of the bullet nose on the base or on a bench. The degree of wobble can be noted by examining this shadow while the bullet is being spun. There is no means of measuring the actual amount of wobble, but the system is extremely rapid, as it takes but a few minutes to go through a batch of 100 metal-cased bullets. On cast bullets it does not appear to be so satisfactory, as the lubricant on the surface of the bullet prevents proper rotation, owing to the smoothly ground surface of the driving wheel.

Loaded cartridges can readily be checked with this instrument by rotating the necks over the bullet and watching the amount of wobble of the case. It is surprising to notice the large amount of ammunition, both handloaded and factory type, which will be found with a decided wobble. Certain of our authorities assert that this wobble or lack of concentricity means absolutely nothing, so far as shooting qualities may be concerned. They are undoubtedly correct in this, particularly with regard to normal usage of the ammunition; but for long-range shooting, at from 600 yards on, carefully selected components and handloads which have been spun will greatly reduce the number of unaccountables one frequently gets in this shooting game.

Mr. Wilson also has designed a couple of bullet spinners, both of which he brought to the National Matches in 1935. One of these is of wood and so simple that it can be manufactured by any energetic handloader. It consists of a small oak block supporting two one-half-inch square sections of similar wood. One of these blocks is carefully milled out to hold the head of a cartridge, and the design is such that anyone could manufacture this tool to accommodate any form of cartridge case. A groove of the "V" type is formed to support the neck. A string is wrapped once around the body of the cartridge case and passes through two holes in the base block. This small unit, less than six inches long, is then clamped in a vise, either in a vertical or a horizontal position, and the string

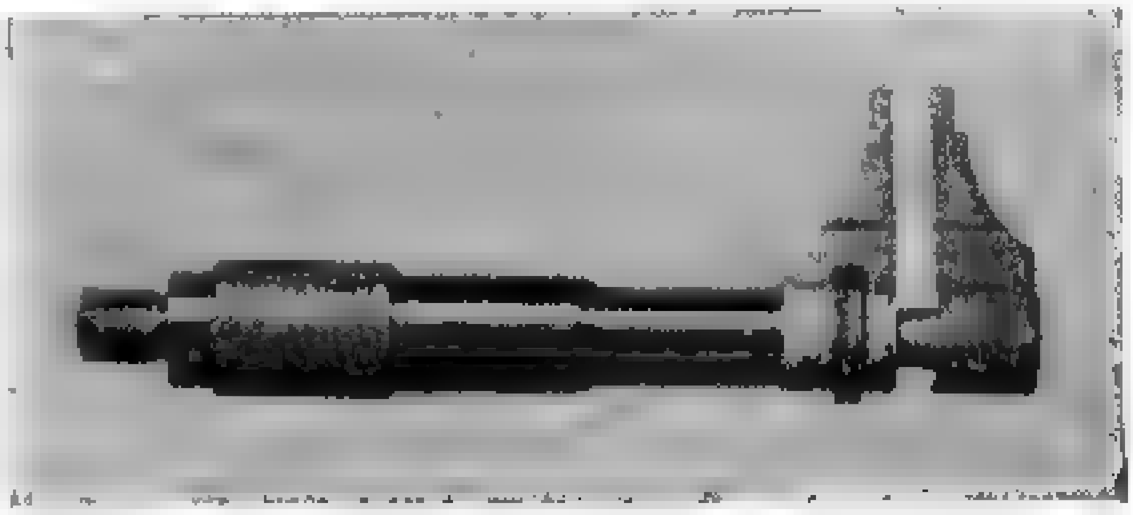
used with a sawing motion to spin the cartridge. Guided in its "V" blocks, the case cannot wobble. The shadow of the bullet on the base will clearly indicate whether or not it is properly aligned in the case neck.

Mr. Wilson brought another spinner, constructed with a toolmaker's precision and with the greatest attention to detail. This spinner is not on the market at this writing, and it is quite doubtful if it ever will be. It is just a toolmaker's idea of a precision instrument which not only discloses the fact that a bullet is not true but reveals the exact number of thousandths that it may be out. The designer uses this for his private testing of Frankford Arsenal Mark I bullets for precision handloading designed for long-range shooting.

The body of this tool is built with two chucks, each of which is ball-bearing, the base chuck being equipped in addition with ball-thrust bearings. The bullet base is inserted into this specially designed tapered chuck, which does not permit of any play, and the thumb nut of the nose plunger is pulled out, as may be seen in the illustration. This withdraws the nose chuck and permits insertion of the bullet. A spring then returns it to bear evenly on the bullet, holding it in perfect alignment in these carefully ground chucks centered on "V" blocks. Measurements are taken with a Federal micrometer dial gauge reading in one-half thousandths of an inch. It is a simple matter to estimate figures as fine as one-quarter thousandths (.00025). The unit is either clamped in a vise or attached to a bench by means of screws. The plunger of the dial gauge is brought into contact with a side of the bullet and the dial set at zero. A string wrapped around the axis of the base chuck is then pulled backward and forward, spinning the ball-bearing chuck and its bullet. A glance at the dial gauge shows the plus or minus variation of these bullets. In using this instrument the author found several F.A. and commercial specimens in excess of five one-thousandths (.0005) out of true and a goodly quantity varying one-half of this figure. The cost of such an instrument, however, would be prohibitive unless the handloader were sufficiently ingenious and equipped with suitable tools to construct it himself. The gauge alone sells for approximately $15.00.

Mr. Wilson is planning on a similar design, less elaborate in construction, which he may possibly place on the market. In place of the dial gauge, he plans to hinge a small steel arm in such a position that it will contact that portion of the bullet which the handloader desires to check. This arm will extend upward and the variation will be multiplied tremendously on the protruding end. This "wiggler," as the designer calls it, will enable the operator to approximate the amount his bullets are out of true. For precision loading such as is demanded by long-range shooters, it is permissible to have a bullet approximately .002 out of round. In a batch of 100 or so bullets, you will frequently find an occasional one or two which will run as much as .010 off center. Bullets of this nature might well explain that unaccountable shot at 1000 yards.

Straight-Line Tool. One of Mr. Wilson's master developments is a precision straight-line tool which offers everything except speed, and for certain types



Inside micrometers are extremely useful for gauging neck diameters. Minimum diameter possible with this unit is .200 inch

of work speed is the last thing to be desired. This tool is clearly illustrated, with its various component parts. The cartridge case is pressed into a shell holder very similar in design to that used in the trimming of cases. This shell holder is ground to exactly one inch in diameter and fits into a one-inch hole reamed in the body of the tool. The case, therefore, is guided in an absolutely straight line free from tipping or buckling while the neck is being resized. A properly designed neck-sizing die is screwed into the end of the tool, the case dropped into the instrument with its shell holder as guide, and a plug properly fitting and with a stop shoulder to prevent over-resizing is used to force the shell into the neck-sizing die.

Should the handloader desire to ream his case necks, it must always be done while the neck is supported in a sizing die. This Wilson tool uses a special die into which a carefully ground reamer is fitted. It is rotated by hand until it penetrates the neck of the case. Due to the system of guiding with a long pilot in the neck sizing die, it must enter the case neck in perfect alignment, thus eliminating the tendency to ream the neck with walls of uneven thickness. Since lack of uniformity is one of the chief criticisms of cartridge-case necks, the thick portion is trimmed in excess

of the thin section, thus restoring the neck to perfect balance.

In designing this reamer Mr. Wilson experimented with case necks until he had his reamer of proper size so that the necessity of using an expander with metal-case bullets is totally eliminated. This is not the simple task one might think, since the brass neck will spring back when relieved from the constriction of the sizing die, and this must be taken into consideration in selecting the proper diameter of reamer—otherwise these necks will be too large to hold the bullets. With this tool it is not necessary to re-ream case necks after the initial reaming; to prepare them for reloading purposes, one neck-resizes the case only. If cast bullets of a somewhat larger diameter than .3085 are used, it is, of course, necessary to use an expander plug.

The shell is removed from the die by the simple process of punching it out with a rod, and owing to the weight of the instrument it may be held in the hand during this process. One then merely empties out all reamer chips, and the case with its neck perfectly centered both inside and out is ready for the powder charge, primer, and bullet. Additional attachments for this tool permit it to be used also for the seating of bullets in perfect straight-line, with the body of the case supported by the shell holder to prevent any tipping.

On a visit with Harvey Donaldson, noted experimenter of Fultonville, New York, several years ago, the author picked up a useful tip which he has since been using very effectively in his own work.

In loading certain calibers Harvey found that the loaded cartridges appeared very similar to others, and accordingly desired to place some positive identification on them. His system was quite simple—he stamped a letter or figure on the bullet.

This sounds like a complicated job, but it is really quite simple if you have the proper equipment. Letters, figures or special symbols can be obtained in a plain hand-cut marking stamp with a sharp face, so that a very light hammer blow is all that is necessary to mark brass, copper or lead. Harvey's system was to stamp on the bullet, particularly a metal-jacketed bullet, just in front of the case neck, a small "o," "4" or whatever symbol he desired to use. This was quickly and neatly cut into the bullet jacket with no damage or mutilation, and since it is in front of the driving portion, it in no way affects the accuracy of the bullet.

On lead bullets, especially those of the flat-nose variety, Harvey's system was to stamp his symbol on the flat-nose portion.

For proper marking in this manner, stamps not larger than 1/20 of an inch tall and of sharp Gothic face are desirable. The writer has found that the Hoggson Brand hand-cut steel stamps (formerly known as the Yale brand), made by the Hoggson & Pettis Manufacturing Company, New Haven, Connecticut, are extremely well made and with proper care should last nearly a lifetime.

These can be obtained in almost any desirable size, running in heights of 1/64, 1/32, 1/24, 1/20, 1/16, 1/12, 3/32, 1/10, 1/8, 5/32, 3/16 inch and up to 1 inch. Of the sizes mentioned, the 1/20 is best adapted to marking material for the gun bug and handloader. Incidentally, these same dies are suitable for marking on ordinary soft-steel tools, for identification purposes. They should not, of course, be used on hardened articles such as resizing dies.

The gun bug will find it extremely desirable to code his ammunition in this manner, if there is any doubt of its becoming mixed. He can also code certain shells by stamping on the head a single identification letter or figure, indicating use of that shell in a particular rifle or revolver.

The way to hold the bullets or shell necks during the process of stamping is to use a small V-block. This prevents slipping and holds the bullet or case neck firmly and without mutilation.

A useful block which I saw at Donaldson's and which impressed me so favorably that I purchased one on my return is the Starrett #129 Bench Block, made by the L. S. Starrett Company, of Athol, Massachusetts. This little block is useful for a great many tinkering jobs and should be in your kit. It is a hollow steel casting, carefully ground and machined, and runs about 3 inches in diameter by 1 3/8 inches high. It is ground at both top and bottom, with a perfectly flat surface on top, having a V-groove 5/16 inch wide.

The block has holes on various sides to permit of drilling small rods if desired and may be used with an ordinary pin punch to remove primers on odd shells that you desire to dissect. The cost is very reasonable. The unit weighs but 1 pound, 10 ounces.

Another very useful V-block which the author has used for many years is the Brown & Sharpe #751. It is another low-priced unit, consisting of a carefully ground steel forging, having a shape similar to the letter "M" in cross-section. This little bench block can be used either side up for handling flat or round stock and comes equipped with a detachable clamp. It weighs two pounds without the clamp and 2 1/4 pounds with it.

It runs 2 inches square in cross-section, by 3 inches long and a 90-degree-angle V is 13/16 inch

wide and about ⅜ deep. A round rod up to about ⅞ of an inch can be handled in this block and with the clamp can be held very rigidly during a drilling. This block is perhaps a bit more desirable for marking the larger calibers, although it can be used with numbers as small as .22 caliber with no trouble.

Both of the above-mentioned V-blocks are nicely ground and tempered so that with normal care they will not scratch or batter.

Incidentally, the chap who desires to mark his tools and other gun parts can do so in a neat and effective way and will do well to have a special name stamp made for that purpose. These stamps are hand-cut, and of course made to specifications in any desired size.

The author had one made by Hoggson & Pettis and uses it to label his various tools and micrometers, special screw drivers and other important small pieces. It has greatly reduced the annual loss of small tools through "borrowing." These name stamps are very reasonable in price and with proper care will last indefinitely. On page 120 is an illustration of a set of bullet swages designed and manufactured by Donaldson for his own use. Reference to that picture will show Donaldson's name neatly applied to the body of the tool by means of one of these stamps.

XXIV

THE HEADSPACE PROBLEM IN HANDLOADING

FEW subjects are so thoroughly misunderstood as that ambiguous term "headspace." It is a subject which should be studied very carefully by any handloader, and its principles and application to the arms for which he desires to reload should also be kept in mind.

Just what is meant by "headspace"? Essentially this: the distance between the face of the breech when the action is closed and the base of the cartridge. Headspace, in very simple language, merely means *clearance*. The ideally perfect gun would have a cartridge case which fitted the chamber without any tolerance whatsoever, so that when the cartridge was in place there would be not more than .001 of an inch or practically no headspace or clearance between the face of the breech and the shell. Why do we not actually have such a gun? In the first place, from a manufacturing standpoint, shells *must* vary. This is absolutely unavoidable. The dies used in the forming of cartridge cases are inclined to wear; therefore, in manufacturing, the cartridge must be gauged in maximum and minimum gauges. The dies used to form the shells are invariably of minimum size, therefore the first cartridge cases to be formed with these dies will be slightly smaller than those of a few thousand drawings later.

Despite the fact that the dies are made of the highest grade of tool steel that is practical, and are thoroughly hardened (not merely case-hardened) and heat-treated to give maximum wear, even the soft brass which is being forced into them will cause a certain amount of wearing away of the steel. Therefore, these cartridge cases gradually become larger and larger as manufacturing progresses. The dies are regularly inspected, and when the wear reaches the maximum or "no-go" point, they are discarded and replaced with new ones. Every factory maintains a staff of expert toolmakers and a tool-making division engaged only in the manufacture of dies, gauges, and various forms of special tools used in the manufacture of the cartridges.

The handloader must not get a mistaken idea of the above statement concerning the wear of the die and the so-called "large" and "small" cartridges that are turned out. The tolerance from maximum to minimum is extremely small. In fact, it is nearly negligible. An example of this is revealed in the official specifications for the .30/40 Krag cartridge. Rim thickness may vary from .060 to .064; rim diameter from .535 to .545; overall length of the cartridge case from 2.304 to 2.314. At the shoulder the diameter or length cannot vary more than .003 or .004 before the dies are rejected.

In the .30/06 we have a perfect example of the popular rimless cartridge. The diameter of the base of the shell just in front of the rim—exactly .2 inch from the base—may vary from .4608 to .4698. At the shoulder the measurements call for a maximum of .441 and a minimum of .432. In overall length the tolerances are 2.484 to 2.494.

The chambering of a barrel must also abide by certain tolerances, and maximum and minimum chambers are more or less standardized; the cheaper the gun, the more inclined it is to have an oversize chamber. It is very rare that chambers are permitted to be actually undersize. In the .30/06, at the shoulder of the cartridge case, the maximum diameter permitted in manufacture is .441. The minimum chamber at this point is .442 with a maximum of .443—in other words, from .001 to .002 more space than the maximum factory-cartridge size. These tolerances must be acknowledged in manufacture.

In the older types of black-powder rifles and even those designed for smokeless powder and made twenty-five years ago there is a tremendous variation in case size, and most chambers are quite oversize. The .22 Hornet, for instance, is nothing more nor less than a strictly modernized and standardized version of the old .22 WCF with the black powder eliminated and the 45-grain lead bullet replaced with a similar weight of metal-jacket bullet. If you can come across one of the old .22 WCF cartridge cases which has been fired in a WCF rifle of the Winchester Single-Shot Musket variety, you will find the case so badly swelled that it is impossible to insert it in a modern well-chambered Hornet rifle. Even the old WCF factory loading is inclined to bind in certain places when entered into a modern Hornet chamber.

These so-called "tolerances" in cartridge-case manufacture, as well as in standardization of

chambers, greatly affect the headspace in a rifle. It is also for this reason that the careful handloader who uses a cartridge case which has been "hand-fitted" to his particular chamber through the act of firing and expansion, is inclined to get much better performance with handloads than with factory ammunition, all other things being equal.

Headspace is an extremely flexible proposition. The generally accepted theory of it is that headspace is adjusted at the factory making the gun and cannot be altered at home. As a matter of fact, more trouble is occasioned by this false understanding of the picture than by the actual use of rifles having excess headspace. Despite the fact that your rifle is definitely adjusted at the factory so that the clearance between the average cartridge and the face of the breech is in the vicinity of .004 inch, lack of understanding and careless resizing of fired cases can increase headspace to the point where the cartridge is *absolutely dangerous!*

The writer has a particular pet Springfield Sporter with a minimum headspace. According to factory standards this headspace measures, with all the deductions for cartridge-case size, about .0035 inch. In other words, with an average cartridge placed in the chamber, a piece of shim stock .0035 inch thick placed over the head of the cartridge and held in position through the simple process of pointing the muzzle downward while the bolt is being closed will cause the bolt to close very tightly. I have experimentally resized cartridge cases to the point where this headspace was increased to .017. Such a cartridge might blow the gun up if it were fired. This is pointed out in order that handloaders may fully appreciate the importance of using extreme care in resizing cartridge cases.

In the final formation of any cartridge case, particularly of bottle-neck or taper shape, it is merely driven into a die of that shape. If a rimless cartridge is run into that die .01 deeper than normal, the cartridge case will be made just so much smaller and the headspace will be increased by that figure, assuming, of course, that the resizing die is of identical dimensions with the chamber. *If the resizing die be somewhat smaller* (and most full-length resizing dies *are* smaller), *this will increase the headspace still more!* Bear this in mind. It is very important.

A rimless cartridge enters into the chamber without stopping until the tapered walls of the cartridge case either meet the tapered walls of the chamber snugly or the tapered shoulder where the case is necked down meets its corresponding section of the chamber wall. If a case is slightly small for the chamber, it will enter more deeply and headspace will be increased.

There is an exception to the above statements. Strictly speaking, the undersize cartridge case cannot *always* enter the chamber until it contacts the walls. The extractor will stop it at a certain point as the hook contacts the rim. Obviously the amount of depth is governed by the amount of play in the extractor hook. At best this is reasonably large to permit of odd sizes of rims. Wear in the hook will also permit the case to enter more deeply if the chamber walls do not interfere.

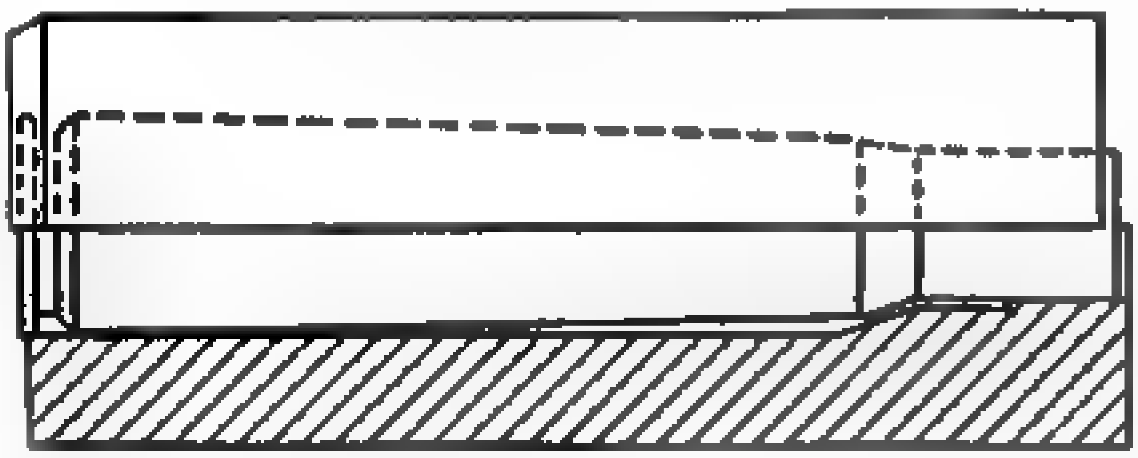
Thus, in firing, the cartridge is driven forward by the firing-pin blow until the chamber walls or extractor snub it. If the former, it centers. If the latter it cannot help but tip, as the extractor bites into but one side only.

Why will excessive headspace cause trouble? This question, often asked and often misunderstood, is really quite simple in both theory and practice. At the instant of firing, the powder is converted into a gas at tremendous pressure. Even in the tiny Hornet cartridge, with normal loadings this pressure runs, according to the various claims of factories and ballistic laboratories, in the vicinity of 40,000 pounds per square inch. According to a natural law of physics, any force exerted is equal in all directions. In other words, that 40,000 pounds per square inch is proportionately the same on the base of the bullet as on the head of the cartridge case, and on the inside walls of this cartridge case. The force of the firing-pin blow drives the cartridge to full depth into the chamber before the primer is ignited. The nearly instantaneous development of pressure expands this cartridge case so that it thoroughly fills the chamber, and this pressure on the walls of the cartridge causes the brass case to cling tightly to the walls of the chamber.

Assume that at this instant you have a headspace of .005 inch, or, in other words, that amount of clearance between the base of the cartridge and the face of the breech. The cartridge case cannot move backward owing to this tremendous pressure on the walls. The case head, however, is totally unsupported, and the result is that the cartridge case stretches under this same pressure on the inside of the head, so that it is forced backward against the breech face until this backward motion is arrested by the locking system of the breech. A stretch of .005 inch is within reason, and the soft brass case will do this nicely. If excessive headspace causes the case to stretch twice that amount, or a distance of .010, there is a possibility of the brass rupturing at the point where the solid head

of the cartridge is thinned down to form the inside walls of the case. The result is a spilling of the entire surplus of hot gases into the breech of the gun, and at this tremendous pressure the damage is quite serious, although in a condition of this sort the breech of a modern gun invariably holds.

It is for this reason that modern military rifles of bolt-action types have so-called "gas ports" in the receiver. The theory is that in case of a head rupture the gases will squirt out through these ports and cause no damage to either the gun or the shooter. As a matter of fact, however, the gas



A useful headspace gauge for determining the headspace or mechanical requirements of a Springfield rifle case. This gauge is made by L. E. Wilson, of Cashmere, Washington. In using it one merely drops the properly resized case into a special chamber manufactured to exact case length. There are steps on each end indicating maximum and minimum. If it projects above the maximum at the head, the cartridge case has too much headspace. If it drops below the step, too little. On the opposite end, if it projects beyond the high step, the case is too long, and needs trimming. If below the low step, it is too short, although it can be used if it meets other requirements

ports do not always work according to theory; many rifles are completely shattered through the stock, the gas running down into the magazine, blowing out the trigger guard, magazine floorplate and similar mechanism, and occasionally actually bursting the breech. These accidents occur infrequently, but their possibility should be recognized by every rifleman.

Cases which have been reloaded a number of times and full-length resized after each loading to restore them to "factory specifications," and then shot continuously in a gun having this excessive headspace, will sooner or later rupture. The best of brass will in time become brittle. The cheapest of brass will let go in a few loadings. Most particularly is this true if the cartridge was primed with a mercuric primer, whether corrosive or non-corrosive. Mercury attacks the brass, changing its crystalline structure and making it extremely brittle and lacking in tensile strength or ability to stretch. The chapter on primers shows illustrations of cartridge cases, the heads of which have been pulled off in resizing dies after the use of mercuric primers. (See page 61.)

In setting up the resizing dies it should be borne in mind that any resizing of the neck of a rimless cartridge case which *in any way alters the shape of the taper* of the neck is more or less certain to affect headspace. This is one of the reasons why the writer heartily approves of the Pacific-type reloading tool and its accessories, even though these tools have certain weak points. The shell to be resized goes into the movable shell holder, and the raising of the operating arm pushes this fired case into the resizing die. It is nearly impossible to push the case into the die too deeply, thereby changing the shoulder; this is due to the very simple fact that when the shell holder is raised to meet the die and the shell is forced in its full length, the shell holder comes in contact with the bottom of the die, effectively arresting its progress. Some Pacific dies are, however, made somewhat short, and in this case it is unfortunately easy to shorten the brass shell in resizing. Intelligent handling will prevent this trouble, especially if the stop nut is clamped in the proper position AND LEFT THERE. Use a new factory case as a gauge in setting this die up, and then fix it permanently in this position. Even in removing the die from the tool frame there is no necessity for disturbing this adjustment.

This danger of altering headspace by excessive shell resizing is not so imminent in rimmed cartridge cases as in the rimless variety, as the neck or shoulder of the case is not used to arrest the forward motion of the cartridge itself. The rim is designed to contact the breech end or face of the barrel as well as to offer a grip for the extractor. It is possible, however, to change headspace slightly in rimmed cases, as this rim is battered or thinned down through careless manipulation in resizing dies after repeated reloads. When the rim of a cartridge becomes visibly battered, it should be discarded.

It will be seen that the problem of headspace is not only one of rifle manufacture but one which should be understood in principle by the handloader. He should examine all cases after firing, to notice indications of partially ruptured or stretched heads and cracked necks. If he finds many such indications it will be both wise and economical for him to discard that particular batch of shells.

Despite the interesting fact that pressure is recorded as "pounds per square inch," the shooter is incorrect in his assumption that when a cartridge registers 40,000 pounds per square inch, it neces-

sarily means that there is 40,000 pounds pressure on the face of the breech bolt. As a matter of fact, this pressure is astonishingly small. A 40,000-pound Hornet cartridge, for instance, is so low in breech-face pressure that many ordinary actions can be altered to handle this very excellent cartridge. Breech-face pressure is controlled by the inside diameter of the cartridge case at its largest point—just in front of the solid head. In the Hornet this diameter averages about .240 inch, hence the area of the section creating the *bolt-face pressure* is only .04524 square inch—the accepted formula for determining area being as follows: square the diameter and multiply by .7854. Thus we find that a breech-face pressure of something under 1850 pounds is exerted on the face of a Hornet breech mechanism with the pressure level at 40,000 pounds.

In the Krag cartridge with the same pressure level (40,000 pounds per square inch) we find a different picture. Here the diameter of the inside face of the cartridge case is .375 inch; thus with the same formula we find that the area of the thrust portion is actually .11045 square inch. This means a pressure of 4400 pounds on the breech-bolt face—nearly three times as much. These pressures depend entirely on the problem of uniform friction of the outside of the cartridge case, which permits it to stick to the walls of the chamber. Thus does a cartridge case function. At the instant of firing, the pressure expands it so that the outside walls of the case cling to the inner walls of the chamber. The pressure is so great that the cartridge case cannot be moved as long as the pressure continues; thus a case can stretch only until its rear face or head contacts the breech bolt. If there is any give to this, the case will stretch even more.

Should there be any excessive headspace, the case will be propelled forward in the chamber by the force of the firing-pin blow before the primer is ignited. There ignition occurs, building up a heavy pressure which causes the cartridge case to cling tightly to the walls of the chamber, leaving the head unsupported. Two things then occur—the cartridge case can stretch at the head or solid portion where the walls of the case join the solid head, due to lack of adhesion at that point—or the primer will be forced out. Pressure on the primer? Negligible, yet of extreme importance. Primer pressure is, normally, that pressure of combustion which leaks through a flash hole to force the primer out of its pocket. It really is quite low, but effective; in fact, machine guns have been designed to function through this backward pressure, not of the cartridge case but of the *primer*. Normally, the pressure on the primer, which is created by the gas leaking backward through the .08-inch flash hole is controlled not by the size of the flash hole but by the size of the primer. Take a pair of cartridges such as the Hornet and the .30/40 Krag, both developing the same breech pressure of 40,000 pounds per square inch. The .08-inch flash hole has an area of about .005 square inch. According to the calculations of Bertram R. Harper of South Charleston, West Virginia, due to the laws of hydraulics, the 40,000 psi is exerted over the entire surface of the primer or .0162 square inch for the .175 Hornet primer and .0346 square inch for the large .210 Krag primer. Thus at the 40,000-pound pressure level this would give actual pressure against the small primer of 648 pounds and against the large primer of 1384 pounds. This should be clearly understood, since a discussion of increasing pressures by extra-large flash holes discussed on page 35 is not in contradiction. Increasing the flash-hole diameter increases the breech pressure through increased or over-ignition. The above discussion of pressure *on the primer* is based on breech pressure at 40,000 psi.

In this back pressure, the primer expands and is driven backward against the face of the breech bolt in a normal-headspace rifle, and the cartridge case goes back along with it. In an excessive-headspace arm, the cartridge case does not respond as rapidly as the primer, owing to the fact that the heavy breech pressure causes the walls of the cartridge case to cling to the walls of the chamber. The primer, however seated, provided it be friction-tight and have little if any side pressure, is propelled backward out of the cartridge case until it strikes the breech face. The force of this 200-pound blow flattens it more or less and is followed by a retreating cartridge case which more or less "crawls over" the projecting primer. This reswages it into shape to tightly fill the pocket. If the primer is blown too far out, leaking is bound to occur, resulting in what is technically known as a leaking or blown primer. This gas leaking by the primer very frequently stretches the pocket so badly that the case is damaged beyond repair. Should you find any primer leaks in examining a fired case, discard that case immediately. Do not attempt to reprime it.

Primers are by no means an indication of high pressure, although they frequently disclose excessive headspace. Look at it this way. If a primer projects beyond the pocket on a fired shell so that it can be clearly seen and felt, there must be some reason for it. If it were possible to breech your

gun with a typical Mann-Niedner minimum headspace adjustment—in other words less than .001 inch clearance between the face of the cartridge and the face of the breech bolt—how could your primer project even with excess pressures? It might flatten tremendously, but it could not possibly project because there would be no place for it to go to when the pressure started to back it out. The author has examined experimental cartridge

Breaching systems greatly affect the headspace of the gun. On the left is a standard Springfield barrel with a cartridge inserted. Note extractor groove in the large portion of the cartridge case sticking out of the chamber, due to the shape of the breach of the bolt. The entire extractor groove is visible. Right: A close breaching system designed by J. B. Sweany of Winters, California, for the Springfield action. Note alteration of bolt and way cartridge case drops into the chamber so it seats flush with the mouth of the barrel. The barrel is turned out square rather than coned as in the Springfield standard system. This gives complete support to the weak portion of a cartridge case and prevents stretching

cases shot in special-pressure barrels equipped with receivers of absolute minimum headspace. These guns have registered breech pressures in excess of 65,000 to 70,000 pounds per square inch. The primers were badly flattened and in a few cases showed signs of leakage but in no case did they back out of the cartridge case. They could not. There was no place to go.

Watch, then, your primers; not to denote pressure, but to indicate too-great headspace in your gun. The mere fact that one brand will back out and another will not, does not necessarily indicate a difference in headspace; it points out that one primer clings more readily to the walls of its pocket than another.

Many shooting authorities insist that primers are worth watching because they indicate pressures. This may or may not be true. Some ten years ago I submitted five fired .30/06 cartridge cases to a certain laboratory asking its experts to comment upon the possible pressures. These primers were flattened as much as any examples we have ever seen. Came back an S O S letter telling me to tone down the loads, since I must have pressures in the vicinity of 70,000 pounds, and would undoubtedly wreck my gun and possibly myself if I continued to use those dangerous charges. The truth of the matter is that I had been conducting a highly successful experiment calculated to shatter the old theory that primers indicated pressures. I had used a load containing Remington new unprimed shells, Remington 180-grain Palma match bullet, F.A. #70 primers, and 44.7 grains of IMR #1147. To prove this statement, I then submitted to the same laboratory a batch of hand loads duplicating these loads. The results of this report indicated a 78-foot instrumental velocity of 2204 f.s. with a pressure of 32,260. The secret of the badly flattened primers was the deliberate handloading of three kernels of #1147 powder into the primer pocket and seating the primer on top of these kernels. The ignition of this tiny powder charge in the pocket created enough back pressure to seriously flatten the primers. The idea was to prove that occasional grains of powder, falling through the flash hole into the primer cavity, could account for seriously flattened primers and had nothing whatever to do with the pressure developed within the cartridge case. This may reveal to some shooters the reason for excessively flattened primers with occasional cartridges, both factory-loaded and of the precision hand variety. It will also indicate why some "tremendous pressures" are registered upon primers when used with low-pressure reduced charges of bulk powders such as Du Pont Bulk Shotgun, Gallery #75, and Sporting Rifle #80.

Yes, headspace is of extreme importance to the handloader. A careful examination of his primer, while it will tell very little about pressures, will reveal much about the headspace of his gun. It will also indicate when to stop increasing his loads, since continuous flattening of primers reveals that the load is too heavy for those cases or for the gun in question.

NOMENCLATURE OF CASUALTIES

Rupture—Complete separation of the circumference of the case, usually where the head joins the side walls.

Incipient Rupture—Complete separation of a portion of the circumference of the case, showing evidence of leaking gas.

Stretch—Visible separation of circumference of case, apparently similar to rupture but showing no gas leak.

Blown Primer—Primer loosened so that it falls out of its pocket during extraction of the case.

Set-back Primer—Primer showing above head of case.

Misfire—Failure of cartridge to fire when primer shows reasonable firing-pin blow.

Hangfire—Delayed ignition in which cartridge goes off an appreciable period after firing pin falls. This may be anything from a hundredth of a second up to several seconds.

Battered Cartridge—Deformation of cartridge which prevents chambering.

Low Primer—Primer seated too deeply in pocket, causing misfire. This may be due to excessive pocket depths, short primer or incorrect primer size.

High Primer—Primer which projects above face of cartridge head, due to shallow pocket, too-long primer or wrong make or shape of primer for that pocket. Usually forms a minimum headspace against primer, strikes breech face, and is crushed on closing the gun, mutilating priming composition and occasionally causing a hangfire. May even cause premature discharge of gun before mechanism is properly locked.

Pierced Primer—Primer in which gas pressure has blown out section opposite firing pin.

Punctured Primer—Primer in which blow of firing pin has penetrated through primer cup. May be due to excessive firing-pin length, thin primer cup, high anvil, sharp-pointed anvil, or improper shape of firing-pin tip.

Primer Leak—Subclassified into great and small. Usually gas leakage around walls of primer pocket. Should always be investigated. May be due to ill-fitting primer, excessive pressure, powder in primer pocket, stretched head, too stiff a primer cup or too soft cartridge brass.

Light Blow on Primer—Primer shows mark of too light blow of firing pin. Frequently occurs with weakened mainspring or when rifle primers are used in revolver cases. May be due to defective firing pin, light hammer blow, improper shape of point of firing pin, too stiff brass, or grease in mainspring or firing-pin spring.

No Anvil—No anvil in primer to receive firing-pin blow. Rarely happens today and should *never* happen with handloaded ammunition.

Inverted Anvil—Anvil with concave side toward blow of firing pin, failing to fire priming mixture. Rarely happens today but is found occasionally. The author found two commercial cartridges in one box which misfired. Unloading showed inverted anvil. Occasionally found in loose primers, which should be weeded out. No excuse for such a primer to enter handloaded cartridges.

Rings—Annular marks around the case, indicating rough or faulty chamber.

Split Neck—Split in cartridge-case neck extending to mouth of shell. Usually due to faulty brass, poor neck anneal, or long storage causing fatigue. Often found on wartime ammunition but still quite frequently found in commercial cartridge cases, made even today.

Neck Puncture—Longitudinal splits in taper or straight side of case neck, showing leakage of gas, usually due to faulty anneal at factory. Not infrequently occurs on first firing of commercial ammunition. Differs from split neck in that puncture does not extend to mouth of case.

Split Body—Similar to split neck except that split occurs longitudinally along body below neck or shoulder taper. Due to faulty brass, brittle case or oversized chambers.

Draw Mark—Longitudinal scratch on side of case due to scratch, burr or abrasive material in case-drawing dies. Frequently caused by rough resizing dies or abrasive on the shells. In handloading, draw marks indicate poor dies or careless workmanship and should be eliminated.

Laminated Case—Scaly metal. Serious defects or folds in brass at time of original drawing. Major laminations visible to inspectors are discarded at the factory. Occasional minor laminations get by and are revealed to handloaders during their inspection. Such cases are dangerous and should be destroyed.

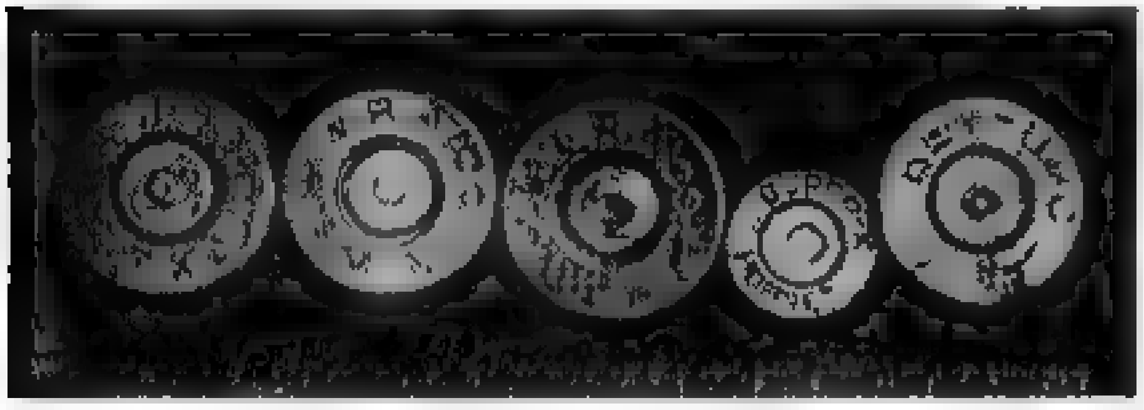
Bellied Cases—Excessive expansion of cartridge case in front of solid head portion on case body. Always indicative of oversize chamber. First step toward rupture. This portion of a cartridge case should be given minute inspection.

XXV

THIS PRESSURE PROBLEM

THE most delicate and most important problem in the realm of handloading is that of safety; it is also of vital importance to others besides the shooter. To this safety problem is closely related the problem of pressure. Today we know more about pressures and safety than a few years ago, and yet, despite our knowledge, we are still greatly handicapped.

The weak point in modern arms and ammunition is not the rifle but the cartridge case—*and*



Pressure gun information: The above cartridges were fired in pressure guns and show a difference in impression which clearly indicates that primers cannot be used to judge pressure. Left to right: 7-mm. German sporting cartridge, 53,400 pounds pressure; 7-mm. Winchester sporting cartridge at 38,500 pounds pressure, same gun, same gauge; .30/30 WCF fired at Winchester plant, registering a pressure of 36,000. Note distortion of primer; Super X Hornet pressure 43,600; test loads of 7 mm. registering 72,000 pounds pressure. Note blown primer

always has been. Cartridge cases are today made of brass, and while the brass now used is supposed to be considerably stronger than that of past years, there really is not so very much difference. Laboratory tests made with .30/40 Krag cases of a certain commercial make, known to have been manufactured in 1900, certainly indicate that these cases were equal to 1937 manufacture. We have improved our guns through knowledge of steels and methods of heat-treating, but we have done very little for the cartridge case.

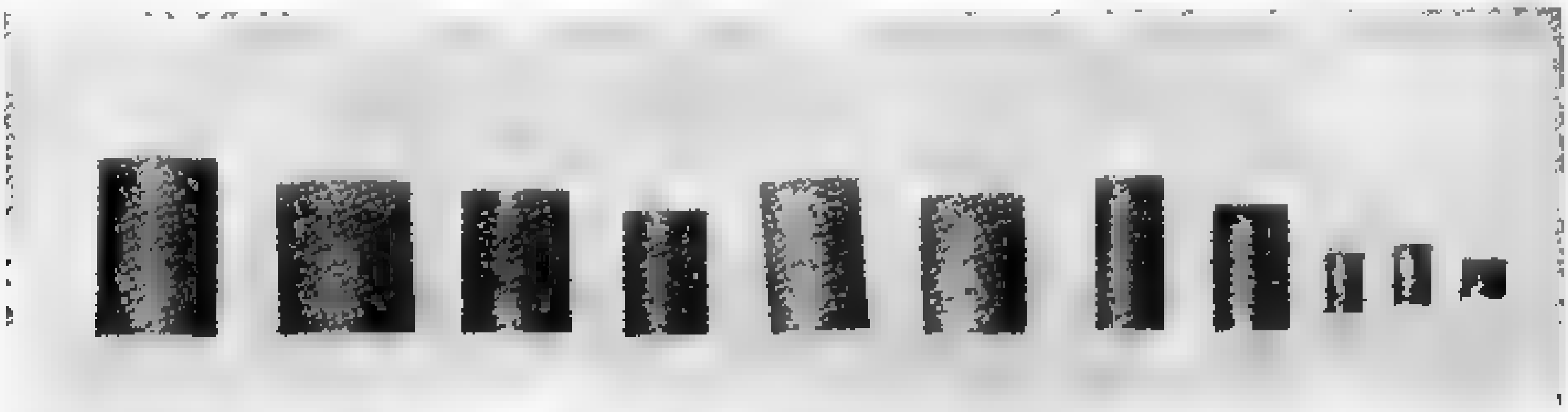
Before 1900, ruptured cases were very frequent, even with low-pressure loadings. It did not require hundreds of reloads to create a fracture; fractures frequently occurred with new factory ammunition. The direct result of this was the development of the Ideal Broken Shell Extractor and similar extractors, which Ideal advertised would "put a head on it." Certain arms makers even went so far as to publish in their catalogs that the actions of their guns were sufficiently strong so that there would be no danger to the shooter or gun in case of shell ruptures.

We are now in an era of high-pressure loadings. Ruptures of any kind at high pressures are extremely serious matters. When a rupture occurs on a 50,000-pound cartridge, it means that gases compressed to 50,000-pounds-per-square-inch pressure are released into the mechanism of the gun where they have no right to be. Something has to happen, and it usually can be depended upon to happen. Reloading at high pressures is a serious problem, and one which is worthy of more than passing consideration. High pressures are tolerated only because they are necessary to achieve certain results. Were it possible to derive high velocities without high pressures, the shooter could be extremely thankful. Unfortunately, high velocities and high pressures appear to go hand in hand, and the present trend of loadings indicates that they are here to stay.

The present method of taking breech pressures is by no means an accurate one. Within the next few years an improved method will undoubtedly be found, and when it *is* found, ballistic engineers will learn things about pressures which at present are unsuspected. The modern rifle will stand a much higher pressure than it is possible to achieve with the present type of cartridge case. The man who insists upon experimenting with high pressures is certain sooner or later to meet with disaster. Even as this is being written, a noted experimenter, a man who had countless thousands of shots with all types of rifles as his background, and who has manufactured precision tools, barrels and accessories, sends me an interesting letter. In it he apologizes for not writing for the past month and explains it by saying that he had a "little bit of trouble" in which an experimental cartridge and rifle failed to deliver the goods at high pressures. His letter in part runs as follows:

"That load was certainly potent, and I suddenly learned that I could no longer count past 42 grains. I could count right up to 42, but I could not count past there. I wanted to show a friend 4000 f.s.

plus, and it took 42 grains to do it. After I came back from the explosion, I found that I had gone to 42, two grains over the maximum safe pressure in that particular combination. The next day I counted 37 abrasions about my face and forehead, any one of which would have put out an eye had it struck it. Most of these were extruded brass. I still have three pieces of steel in my face, parts of the extractor, and one of these is in the middle of my forehead, stuck to the bone. I was going to leave it there, thinking I might have something on you guys when we get older, for being stuck to the bone, it might stop my forehead from ever wrinkling; but it hurt my hat, so tomorrow I shall have it removed. . . ."



Pressure cylinders of various types designed for rifle, revolver, and cannon pressure tests. Left to right: Perforated French cylinder for taking light cannon pressure; French pressure cylinder for heavy rifle pressure; same for medium rifle pressure; same for light rifle, lead pressure cylinder used for revolver and shotgun pressure; same type of cylinder after compressing in pressure gun registering about 16,000 pounds; the standard copper crusher cylinder used for rifle pressure, same cylinder after compression in pressure gun registering 51,000 pounds. The tiny pressure cylinder on the right is a before-and-after version of the standard Frankford Arsenal copper crusher cylinder used for revolver pressures and one after compression at a pressure registering 21,000 pounds. Illustrations approximately actual size.

Not a lecture—not a joke—just a warning. He was using a breech pressure in the vicinity of 65,000 pounds in a modern heat-treated Springfield with a special barrel. The Springfield has been definitely tested at 110,000 pounds' pressure—BUT NOT WITH BRASS CARTRIDGE CASES! The reason for the popularity of the bolt-action arm is the rigid system of locking the breech. In a properly made rifle, the breech is rigid at the time of firing. Lever-action types, slide actions, automatics, and many single-shots have a certain amount of spring or give to the mechanism at maximum pressures. This greatly overworks a cartridge case through stretching it, and means more or less of the same thing as excessive headspace.

In lieu of a better designation for pressures, we must accept the custom which has been in use for more than forty years and call our breech pressures "pounds per square inch." To my mind, it is extremely doubtful whether this is a matter of actual pounds. Several years ago while on a hunting trip, Colonel D. B. Wesson of Smith & Wesson was discussing the pressure problem and plans for the development of a gun and ammunition now known as the .357 Smith & Wesson MAGNUM. "Breech pressure," he stated, "is a problem which has not as yet been solved to my way of thinking. The figures the laboratories give are not 25,200 pounds per square inch but 25,200 'X's.' The figure is comparative only for that type of pressure gun and cartridge." And we might add "operator" as well.

A certain group of .38 Special experimental high-velocity loads prepared by the author were assembled with elaborate precision. All bullets were hand-chosen and balanced with weight tolerances held within .1 grain. Powder charges were held to a variation of .01 grain. The entire lot was all the same and had been loaded at the same time under uniform conditions of temperature, humidity and similar requirements. Twenty-five each of these loads were submitted to the laboratories of Remington, Winchester, Du Pont and Hercules. The velocity figures from the four laboratories showed a variation of less than 10 foot-seconds in the different reports. In other words, they checked nearly identical. In one case the variation was explained by the report—"Instrumental velocity at 50 feet," whereas the other reports gave instrumental velocity at 25 feet. Pressures, however, were an entirely different proposition. These particular loads, because of the careful selection of components and precision loading, ran uniform on the shot-by-shot report as submitted from each place, yet the mean pressures of four laboratories were 15,200, 19,700, 23,500 and 29,600. After getting these reports I knew less about the loads than formerly. Did I have a 15,000-pound load safe for use in normal lightweight .38 Special revolvers, or was it a 30,000-

pound load which would have been unhealthy to use?

A year later I spent a day at one of the laboratories in question, and the boys ran a re-test on a string of ten cartridges of the same original year-old batch, the one difference being that they had remained loaded in new cases for a year. Checking up, I found velocities and pressures almost the same as those originally submitted by that laboratory. In other words, the figures those laboratories gave were uniform, but by no means comparative.

Box of crusher cylinders of French manufacture showing method of packing in an ordinary pill box. This cylinder is almost identical with the FA crusher used for revolver pressures

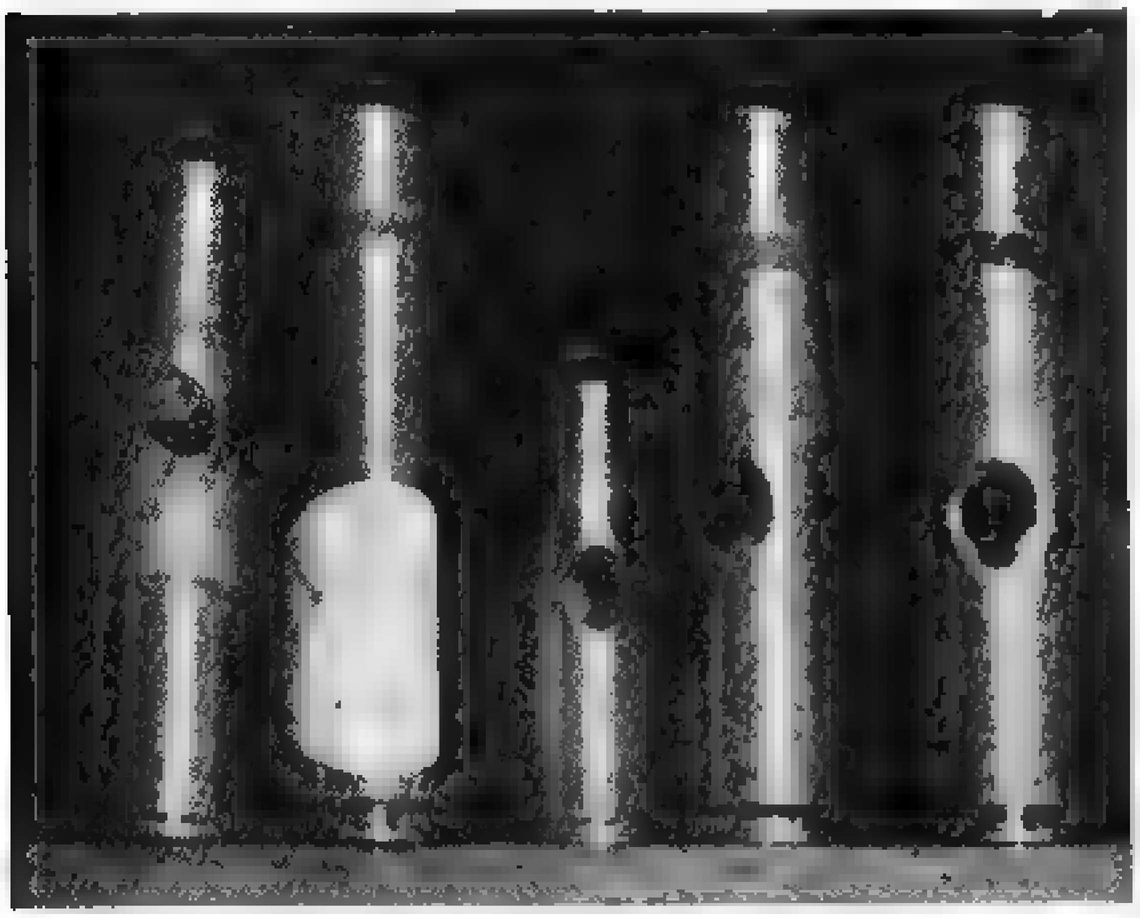
The present system of taking pressures appears quite simple. A standard or special weight barrel forms the base of the so-called pressure gun. For handgun cartridges a pressure barrel an inch or more in diameter and usually about six inches long, is fitted to a standard bolt rifle action. For the .30/06 cartridge, a standard Springfield rifle is converted by addition of the pressure apparatus. A yoke is formed of heavy steel, properly machined and fitted to the barrel over the chamber. A hole is drilled through the barrel into the chamber, extreme care being taken with its size and with the finish reaming. Into this hole a special hardened steel piston is fitted, being lapped in to make a perfect fit yet sufficiently free to permit it to move upward and downward freely. The yoke around the barrel forms a sort of arbor into which a precision-ground screw is fitted, having a perfectly flat end, the bottom of which is truly parallel with the top surface of the piston. The manufacture of a pressure gun has never been an amateur job; it requires the most skilled toolmakers to construct and fit these parts properly.

Operation of a pressure gun requires an intelligent understanding of the various principles involved. It is a task requiring great skill to eliminate possible variations. In theory, however, it is quite simple. A loaded cartridge is inserted into the gun. A copper gas check is dropped into the piston hole and forced downward until it touches the brass cartridge within the chamber. The piston is then inserted into the hole and forced downward with a twisting motion of the fingers which permits the trapped air to escape. The piston is such an excellent fit that unless this twisting motion is used, air will not escape but will be trapped in the piston hole and cause the piston to bob up as though it were backed by a spring.

When the piston has contacted the gas check, which in turn has contacted the cartridge case, a crusher cylinder made of lead or copper is stood on end on the perfectly smooth piston top, and the anvil screw in the arbor turned down to contact the top of this crusher cylinder. It must be set up just so—too tight will give a false reading, not tight enough is dangerous to the gun. With the crusher cylinder in place, the shot is fired; the gas pressure within the cartridge case tears a hole through the brass wall opposite the piston, and the gas pressure is exerted upon the under side of the gas check, which of course expands to prevent leakage past the piston. The force of the blow drives the piston upward, thus crushing the lead or copper cylinder against the anvil screw, short-

Cartridge cases which have been used in a pressure gun. Notice hole blown through brass case during the taking of pressure. Left to right: .22 Hornet; .30 WCF; 7-mm. Mauser. Right: an 8-mm. Mauser case prepared at the laboratory for the taking of pressures. Note large hole drilled in cartridge case and covered by a white paper sticker

ening it an appreciable amount. This shortening is measured in thousandths of an inch and translated by means of the chart prepared especially for each lot of crusher cylinders into a breech pressure



Cartridge cases used to record pressure. Left: .30/30 Winchester. This was previously drilled and the opening covered with a paper sticker to prevent spillage of powder. Beside it is a German Mauser cartridge manufactured by F.N. in Belgium. A sticker is pasted over it to hold the powder charge before the cartridge is inserted in the gun. This is the conventional foreign pressure cartridge. Center: .22 Hornet. Right: two 7-mm. cartridge cases used to register pressures. Mutilation around the hole is caused by pushing the gas check into the cartridge case in extracting from the gun

reading "pounds per square inch." This chart is known as the tarage table.

So much for the mechanical theory. What is the mathematical practice involved? Quite simple. The average piston has a diameter of .206 inches. Thus the area of the chamber end of the piston is about .162 square inch. The crusher cylinder has a known area, a known length, and a known density, and tarage tables are prepared by actual tests. Therefore, with these known figures, the tarage table is prepared by mathematical calculation, thus obviating the necessity of figuring results on each shot.

There are several types of crusher cylinders in use. Small-bore rimfires and most handgun pressures which do not exceed 15,000 pounds pressure are taken on cylinders of pure lead .500 inch long and .330 in diameter. At Frankford Arsenal very tiny copper crusher cylinders are used, averaging .195 inch in length and .121 in diameter. Samples of both types fired in the same gun show pressures translating to "20,000 pounds," the lead cylinder being shortened or barreled out to a length loss of .044. The tiny FA coppers shorten .0625. For rifle pressures we use a copper crusher cylinder with a diameter of .225 and a length of .500. Samples measured by the author when fired at a pressure registering 50,000 pounds, measured .4135—a loss of .0865 inch.

In Europe the lead cylinder is not looked upon with favor, so a small copper type very similar to the Frankford Arsenal revolver copper is widely used. These cylinders are slightly shorter and measure .187 inch in length. A box of them in the author's laboratory bears the label *"Laboratoire Central de la Marine, Paris. Lot 8250. Cylindres Crushers de 4 m/m 90X 3m/m. Tarage du 1929."*

Despite the attempts at standardization of pressure-gun specifications, certain inaccuracies are bound to creep in. Assuming that guns are made as perfect as possible at the start, here are a few of the possibilities of inaccuracy in readings:

1. Improper fit of piston in piston hole due to wear or erosion.

Cases as they are removed from a pressure gun: 7-mm. rifle and .22 Hornet. These were not drilled before taking the pressure

2. Variation in friction between piston and piston hole walls due to different lubricants used and varying quantities for each individual shot.

3. Location of piston hole in chamber. A tenth-inch difference measured from the head of the case will greatly affect the level of the loading.

4. Variation in formula for annealing of crusher cylinders, creating soft or hard spots.

5. Variation in length and diameters of crushers due to problems of manufacture.

6. Temperature of barrel for each shot and consequent variation due to unequal expansion of piston, the piston-hole walls, and its effect on the lubrication used.

7. Variation due to the use of pre-compressed cylinders (crushers which have been previously compressed through application of a known pressure in some form of mechanical press).

8. Variation in readings due to the human element requiring the hand-tightening of the arbor screw after each shot.

9. Lack of uniformity and standardization in the methods of training operators to handle pressure guns.

10. Lack of definite standardization of piston sizes for various calibers.

Each laboratory uses its own method to determine pressures, and its results cannot be compared with other results obtained in the same type of pressure gun in other laboratories. Each keeps its own standard of working pressures, and the results of one laboratory do not compare favorably with those of another. This does not necessarily mean actual variation in pressure figures, but it does mean variation in methods of arriving at those figures.

In handloading one must bear in mind that the available figures on loading data usually come from the laboratories of Du Pont or Hercules. These figures are obtained with extreme care, and those recommended for a particular cartridge by these makers of smokeless powders are perfectly safe in the so-called maximum pressure brackets *only when used in proper guns!* That is something no powder company can tell the individual. He must have sufficient intelligence to figure for himself and determine just what is the "proper gun." It is always wise, therefore, to stay away from truly maximum pressures unless one has absolute knowledge that his particular gun will handle these loads in a satisfactory manner.

Why all this mystery about "different guns"? Simply because there is a difference in guns even of the same make. The meager fact that one has a bolt-action gun does not necessarily mean he has a thoroughly strong mechanism. On occasion he may find to his surprise that his gun is not strong enough to handle some of the concoctions he develops in his loading laboratory. He should therefore analyse his guns carefully. If they breech up solidly he can feel that he is at least 50% secure, but he should never be satisfied. He should look to the condition of his firing pin or striker and determine whether it is shaped properly to explode the primer without danger of puncture; and whether it may be too long or too short. He should decide whether the firing-pin hole in his breech face is too large for the striker, and above everything else he should watch his primers as stated in Chapter VI. Primers in no way indicate the pressure developed within a cartridge, but they show the intelligent handloader *when to stop*. If his primers flow back into the firing-pin hole in the breech face, he may not have a maximum pressure but he has an unhealthy one for that particular gun. The remedy is to change primers and shells, or to have the weakness corrected by a competent gunsmith.

Handloading is not dangerous for intelligent persons. Countless thousands of Americans have for more than three-quarters of a century practiced handloading, and during that period millions of rounds of ammunition have been assembled and fired; yet a person who handloads for maximum power with no regard for his particular gun is continually inviting disaster, and if he staves it off, he does so only for an indefinite period and by chance.

Even if you have no objection to blowing up your pet $75.00 rifle or having about three-fourths of the right side of your face torn off, worry a moment for the witnesses who may be near by. Mrs. Jones's boy standing a few feet to one side to watch the firing process may not look so good after all the pieces of the gun have finally returned to earth, and his mother may not greatly appreciate the change in his appearance.

There should be one slogan constantly practiced by handloaders, *"Safety first, last, and always."*

XXVI

REDUCED, MID-RANGE, AND TARGET LOADS—REASON AND IMPORTANCE

ONE of the primary excuses for this handloading game is the very important fact that one can prepare a load to meet any individual requirement. One of the most important of these requirements is that of reduced loads. A shooter may take a powerful military or hunting rifle and develop low-power charges for small-game hunting or for target work. He not only can fit these reduced loads to the particular requirements in mind but he can also adapt them to individual guns. This latter is of extreme importance. Reduced loads that do not produce accuracy are of little or no value.

There is another very important angle to the reduced-load idea—cost. The primers cost as much as in full-charge loads, but the powder charge is particularly economical. In many cases satisfactory results can be obtained with far less than half of the normal charge or the equivalent in some powder better adapted to light loads. Reduced charges greatly minimize both the recoil and wear on the gun. They enable the shooter to use economical bullets of suitable size in his barrel even though they may be of an entirely different "caliber" and shape. He may use expensive metal-jacket or low-priced forms. He may use full jackets, soft points and hollow points. In short he may use any style and type of bullet which in size is suitable for his particular barrel dimensions.

It is even possible to produce accurate and low-power indoor loads for target practice with a military rifle. Some years ago I was experimenting with the 7-mm. rifle and was seeking the lowest power loading of Hercules Unique powder which it was possible to consume in a big 7-mm. case. I got down to ten grains and wrote the Hercules Experimental Station. They ran a series of tests and found that a charge as low as five grains would work in this caliber, particularly if the muzzle was elevated between shots. They tried the 5-grain load, using a 139-grain gas-check, getting excellent accuracy for 25 yards with a muzzle velocity of 850 f.s. and a pressure too low to be recorded. With a 120-grain lead bullet Hercules found good performance with four grains of Unique which registered a muzzle velocity of 875 f.s. and a pressure of 7800 pounds. Another excellent load was the 88 grain lead with 5 grains of Unique, registering a muzzle velocity of 1140 f.s. and a pressure of 7400. Eight grains of Lightning with the same bullet gave a velocity of 875 with a pressure of 5000 pounds. Even the 139-grain full metal-jacket military bullet worked out well in these very light loads. Ten grains of Sharpshooter gave a muzzle velocity of 1100 f.s. with a pressure below 10,000 pounds. Sixteen grains of Lightning with the same bullet registered 1225 f.s. with low pressure. Eighteen grains of #80 gave 1475. All of these loads, particularly those below 1300, were very quiet to shoot indoors and the accuracy at 25 yards left nothing to be desired.

Back at the turn of the century the reduced load idea in practically all calibers meant chiefly the use of a round ball, and many satisfactory loads were worked up using first black then semi-smokeless and finally smokeless powders.

There is one major thing which must be remembered by the experimenter who plays with reduced loads. A grain or less variation in his light powder charge may spell the difference between accuracy and inaccuracy with his particular group of components and the barrel in question. The reduced load problem is one wherein the experimenter plays with his own loads rather than accept the recommendations of others. Reduced load data in the tabulations of this book are published as a guide that the shooter may know the approximate ballistics of his concoctions. One particularly accurate load in the 7-mm. which I developed for my particular Winchester #54 was the 139-grain gas-check and 19.0 grains of Hercules #2400 which gave a muzzle velocity of 1775 and a pressure of 23,900 pounds. In my gun, this combination would do 1¼-inch groups, and occasionally better, rest-shooting at 100 yards. In a friend's 7-mm. converted Spanish Mauser military gun this load was useless and could not be counted upon to do better than 2½-inch or 3-inch groups at that range. Experimenting with it, my friend found that an 18.2-grain charge grouped approximately the same as my own. Some 20.5 to 22.0 grains, same powder and other components, also gave superfine accuracy, but my thoroughly accurate load didn't perform so well in his barrel.

This same peculiarity of different barrels and their susceptibility to various loads affords a source of practically endless experimentation for the careful handloader. If he records the results of his experimental work he will find that the data of his inaccurate loads are fully as important as those on more successful developments.

Problems of Interior Ballistics. There are numerous things frequently cropping up in this game of interior ballistics which cannot be explained. We have the problem of exterior ballistics fairly well licked, but the true happenings between the time the firing pin falls and the bullet leaves the muzzle of the gun are not thoroughly understood today, regardless of what certain technicians would lead us to believe. The author was once told by a well-known authority that the reason for the inaccuracies of certain reduced, mid-range, and full-charge loads in certain barrels was that there were certain "critical points in the velocity of particular bullets which caused some peculiar form of barrel vibrations, etc., etc., which created inaccuracies." It sounded logical. Yet in my Springfield, a certain reduced load at a certain velocity in the mid-range brackets is what one might call in the vernacular "lousy." Assuming that this was the critical velocity, this particular authority was possibly correct. Yet when this velocity was duplicated with an entirely different kind of powder, the accuracy left nothing to be desired. How can you explain that sort of thing? Pressure? Perhaps. The pressure of the two loads was slightly different. Yet the second powder, loaded at the same pressure as the first, gave good accuracy, but the first, loaded to the pressure level of the second, was none too good. Quite probably it was a combination of velocity and pressure, or perhaps it was *the somewhat different type of ignition.* The truth of the matter is that the question has never been satisfactorily explained. But it really does not matter. The reduced load as well as the high-pressure load problem requires, for best results, careful fitting to the gun in which it is to be shot.

Reduced loads do not necessarily mean special components, particularly with regard to bullets. Standard bullets with proper powder and proper loading will deliver extremely satisfactory results. The handloader must always bear in mind, however, that accuracy is the primary requisite of reduced loadings. With proper loads he can turn practically any kind of high-power or medium-power gun into a satisfactory all-round weapon. This is also true of handguns. Some excellent reduced loads for medium and large power guns can be developed for indoor shooting. For outdoor work and so-called mid-range, loads can be developed to give light recoil and little noise, and still maintain accuracy suitable for 50 yards, which would be as far as the normal target shooter wishes to strain his handgun.

When the .45/70 rifle was adopted by the United States Army, it immediately found favor with sportsmen of that period, and since reloading was the thing of the day, it was only natural that reduced and mid-range loads should be developed. With the two official government bullet weights of 405 and 500 grains, reduced charges were more or less impracticable. The 148-grain round ball proved to be reasonably accurate when properly loaded, and this became quite popular. John M. Barlow of the Ideal Company then set to work producing his famous "collar button" bullets in this caliber and in various other popular types, a "collar button" averaging approximately the same weight as the round ball in any particular caliber, but providing superior accuracy when properly handled. Reduced loads of various kinds in the old .45/70 were widely used by soldiers for hunting purposes in supplying isolated army posts with game for food. National Guard units used reduced loads for target practice for very definite reasons: first, the economy of the light charges; and second, the reduction in recoil, which enabled the inexperienced rifle shooter to keep better control of his weapon.

Bullets for Reduced Loadings. At the turn of the century, with the .30/40 Krag cartridge becoming popular, Dr. W. G. Hudson, an ardent rifleman, set to work developing satisfactory bullets for reduced loadings. It is said that his first reduced-load bullets of the cast variety gave 200-yard groups more than 24 inches in diameter; but after improving the shape, length, and other minor features, he was able to get this down as small as three inches. Think that 3-inch group over, you precision riflemen! The Hudson bullet of that time ran 180 grains in weight, and its excellent accuracy was obtained with 12 grains of Du Pont Annular Smokeless, the pioneer Du Pont dense powder. Eventually the factories began to load reduced-charge .30/40 cartridges with a 170-grain swaged bullet to be used by small-game hunters and by guards who did not want an overly powerful full-charge load because of the dangers present in its use. Thus began the development of the so-called "guard cartridge." Various types of these reduced loads were developed for military duty, including a single-ball load and the unusual Frankford Arsenal development of a double-ball

load—two round lead balls loaded into the neck of the Krag cartridge case.

Powder for Reduced Ranges. In the notes elsewhere on Gallery Rifle Powder #75 will be found information concerning development of the true mid-range powder, of which Laflin & Rand Marksman was the first. This same powder later became known as #75 and won many matches at all ranges up to 600 yards.

Even the Springfield .30/06 cartridge was at one time loaded by Frankford Arsenal with a lead bullet. The writer has shot many hundreds of these on private and government ranges. The Frankford Arsenal load, if memory serves correctly, had about 10 or 10.5 grains of #80 or American Powder Mills "Mid-Range" and 140-grain lead and antimony bullet of about 1 to 40 (about as soft as the average factory bullet). At a later date Frankford Arsenal changed this to a tin and lead alloy slightly harder—1 to 30. The bullet has two grooves and was manufactured both with and without a dirt-catcher groove in front. Pure Japan wax was used as a lubricant. My notes indicate that the bullet ran .3095 in diameter (not .311 as recommended by most makers of cast bullets) and was seated approximately .438 inches out of the case neck. The bullet was of the round-nose variety, approximately .8 inch long. Various other powders, including Lightning, Sharpshooter and one or two others, were used experimentally. Frankford Arsenal data on these cartridges indicate a muzzle velocity of 1100 f.s. and run as follows: "Sight adjustment required for 50-yard shooting: Set military leaf slide at 285 yards; for 150-yard shooting, set slide at 640 yards; for 200-yard shooting, set slide at 815 yards. Accuracy test: In machine rest, mean radius of .32 inch at 50 yards; .55 inch at 100 yards; .95 inch at 150 yards; 1.25 inches at 200 yards. At 100 yards occasional one-inch groups have been made, but the average is about three inches. In twenty or more wartime-manufactured rifles capable of making only 5-inch groups with full-power ammunition, this load averages 4.7-inch groups."

With FA factory loads in this light-charge combination, the author has never seen any particularly fine shooting. Some ten or fifteen years ago he obtained several hundred of these bullets from the Arsenal and loaded them himself, developing loads with Gallery #75 and Sporting Rifle #80 which ran as small as 1½ inches at 100 yards. It was necessary, however, to seat the bullet farther out of the shell than the FA Standard, and to load to slightly different ballistics. Also, for real accuracy, the bullets were loaded uncrimped.

Powders suitable in various high-power rifles for reduced charges include all of the bulk smokeless rifle powders: Hercules Unique, Lightning, Sharpshooter, #2400 and HiVel #3. In the Du Pont line, #1204 and its successor #4227 can be used together with #1147 and its successor #4320. IMR #25½ and its successor #1498 are also suitable for mid-range loads if carefully handled. The average dense powders, particularly of the straight nitrocellulose type, are unsuitable for light loads, as they do not function well at extremely low pressures. Du Pont #17½ and its successor, #3031, have been successfully used in the Springfield by the author at pressures as low as 28,000 pounds, but Du Pont will not recommend this. In very light loads, certain shotgun powders can be successfully used. It is well, however, to understand that shotgun powders burn much faster than rifle powders and thus build up excessive pressures if confined in a rifle cartridge case in too great a quantity. Du Pont bulk shotgun powder works excellently when used in light loads either in revolvers or in rifle cases, particularly when of the straight or straight-taper variety. In bottle-neck shells it is inclined to build up high base pressures and erratic shooting.

A companion powder to this is Hercules "E.C.," an old-time shotgun powder of bulk nature which is still manufactured at this writing. One should bear in mind, however, that there are two distinct types of "E.C."; one known as "E.C. Blank Fire" and the other as E.C. Shotgun." The shotgun powder is colored a pale or deep orange and can be used for rifle and handgun loads in light charges. The Blank Fire powder has never been sold to the public but is frequently encountered in small lots. The color of this differs from the shotgun powder in that it is a *bright pink. It must never be used under any conditions!* This powder is the fastest-burning smokeless powder commercially developed and is intended only for smokeless powder *blank* cartridges. It builds up an excessively high pressure even without bullets, and should even a light load be used with a light-weight bullet, the pressures would undoubtedly be so serious as to wreck the gun. The powder was colored pink for a very definite reason—danger. If you run across any of it, do not attempt to use it.

Infallible Shotgun and Ballistite, two nitroglycerine dense shotgun powders, are also satisfactory for *very light* loads in rifles and medium loads with heavy bullets in handguns. Extreme care should be taken with them unless details of the particular lot are thoroughly understood. Infallible is in the form of round discs, in appearance identical with the Unique powder. Ballistite is in

the form of square flakes. Both powders are heavily graphited.

If you have no definite information concerning lots of smokeless powders which you have on hand and desire to use for reduced charges, it would be well to write directly to the manufacturers of each powder, listing the caliber in which you plan to use it and the weight and type of bullet used, together with the approximate velocity you are seeking. They will gladly help you at no charge and offer recommendations concerning its use. Bear in mind that no one understands the characteristics of a particular powder any better than the laboratory operated by its maker.

In the appendix of this book are listed the factory specifications giving diameters and weights of all available factory bullets as manufactured in 1937. The reduced load having been decided upon, the handloader discovers that he has an excellent choice of factory components to fit his barrel. It is necessary, of course, for the handloader to understand the measurements of the barrel for which he is to load. For reduced loads in rifles, factory alloy bullets can be used if they run from about .002 inch undersize up to .004 oversize, and with properly developed loads they should give reasonable accuracy. These factory-swaged bullets are quite soft and handloaders must bear this in mind. Most factories use alloys of lead and antimony, and the average "lead bullet" alloy will be about 30 parts lead to one of antimony. It is impossible to give an exact formula; not only do they vary according to the caliber and design of the bullet, but certain factory changes also are made from time to time, of which nothing is said in any factory literature.

Generally speaking, one can assume that cartridges for rifle use with factory lead bullets can be loaded at from 1500 to 2000 f.s. in proper barrels.

Jacketed Bullets. How about jacketed bullets? This is an entirely different problem yet one of extreme interest to the handloader. The .25/20 jacketed bullets cost about one cent each and can be used with excellent success in various low, mid-range, and full-charge loads in various .25-caliber rifles, including the .25/35, .25/36, .250 Savage, .25 Remington, .25 Niedner and .257 Roberts. Various .30-caliber jacketed bullets such as the 7.65-mm. Luger, 7.63-mm. Mauser, and .32 A.C.P. .32/20 and .30/30, can be used in various .30-caliber rifles up to and including the Springfield. Many of these low-priced bullets are ideal for target and hunting loads and for certain types of loadings are far superior to expanding bullets originally designed to fit the cartridge. Jacketed bullets will not expand as freely as the cast or factory-swaged variety and must be handloaded intelligently. These bullets should be used in the size closely approximating the groove diameter of the barrel, although .001 inch either way will not appreciably affect the accuracy.

Sighting for Reduced Loads. One thing a handloader will soon learn is that his various reduced loads greatly affect the sighting of his gun. If the arm is equipped with micrometer peep sight, the problem is greatly simplified, since it is merely necessary to record the various sight settings after they are determined by actual firings. If an accurate load is obtained, the sight setting should be recorded conveniently in a notebook, so that when that particular load is next used, the adjustment may be made without wasting any ammunition.

In one of the author's Springfields, the most accurate load he has been able to develop is with the Mark I 173-grain bullet. This load is economical to assemble, and in fact costs less than many of the so-called cast bullets, as this Mark I bullet costs me delivered from the Frankford Arsenal less than ¾ cent each. Having experimented with every velocity from about 2900 f.s. to 1500 f.s. with this bullet, I finally settled on a variation of the famous "International Match Load," using the bullet at about 2200 f.s. One would hardly call this a reduced load, but it is a long way from being full charge. It is economical to load and extremely easy on the shoulder for prone shooting at 200 yards. I have had excellent success with it at approximately the same velocity—2000 to 2300—using #15½, #17½, #1147, HiVel #2, HiVel #3, #4064, #4198, #4320 and #3031.

The reduced and mid-range loads suggested in the load tabulations are for the most part carefully tested developments. A great many of them the author has personally tried and found to be excellent. On the others he has the word of well-known experimenters or of the various laboratories which have done actual testing. Bear in mind that for individual guns it is usually necessary to vary these charges somewhat.

Do not attempt to overwork your components. Never try to drive light-weight bullets at an excessive speed if you are seeking target accuracy. If you stay within reasonable bounds you will be certain to develop reduced loads for your rifles and handguns which will deliver the goods in an excellent way. In handgun calibers, the .38 Special is by all odds the most popular on the American market today. This cartridge lends itself to everything from light "cellar" charges up to superpower

Magnum loads. The unfortunate part of reduced loads in revolvers, however, is the inability to adjust sights. Many of these loads will shoot either high or low, but they can be made to shoot accurately even though the sights of the gun will not permit of proper adjustment to center groups at point of aim. If you are interested in shooting small groups, an achievement that indicates careful holding and good control of the gun, reduced loads will enable you to practice indoors economically. In the .38 Special you can either use cast, round balls or purchase in five-pound lots the 000 Buck. This makes an economical load, since these balls have a diameter of .36 and run slightly better than 100 per pound. The last time the author purchased these, he paid the retail price of 75 cents for a five-pound bag of shot, approximately 15 cents per hundred for the "bullets." In his particular guns he tried the various powders and found that 2.0 grains of Bullseye, 2.3 grains of #5, or 2.7 grains of King's Semi-Smokeless shot extremely accurately with little noise and recoil, giving a velocity of about 700 f.s. Still better loads included 3 grains of Du Pont Bulk Shotgun or the same charge of Hercules E.C. Three grains of Infallible shotgun also worked excellently. Four grains of #80 was quite unsatisfactory but 4 grains of Gallery #75 shot well. The above comments were based upon shooting in a six-inch barrel.

The best of these loads were those shot with bulk powders. Erratic shooting was noticed with the bullet seated in the mouth of the shell, so the unresized shells were belled gently at the mouth to remove the crimp, and a #000 ball pressed inside the shell with the fingers and seated until it came in contact with the powder charge, using as a "bullet seater" the rubber end of an ordinary lead pencil. In loads such as these the handloader will do well to experiment. Bearing in mind that his shotgun powders are suitable only for light loads in rifles or revolvers, he can proceed to assemble his components until he develops the right combination to deliver the results he desires.

Five Classes of Reduced Loads. In discussing reduced loads for rifles, J. R. Mattern, in his excellent book, published ten years ago, listed five classifications upon which no writer has been able to improve. Mattern's facts were determined through countless thousands of his own experimental firings, and these classifications should be adopted by the handloading fan. Mattern lists them as follows:

Class 1. Velocity 600 feet. "Cellar" loads extremely light. Accuracy range about 50 feet.

Class 2. Velocity 800 feet. Gallery loads only slightly heavier for 25-yard indoor shooting.

Class 3. Velocity 1000 feet. Short outdoor loads. Accurate range from 50 to 100 yards.

Class 4. Velocity 1400 feet. Standard outdoor reduced loads with accuracy range to 200 yards.

Class 5. Velocity 1800 feet. Mid-range loads accurate to 600 yards in .30 caliber rifles.

The major advantage of adopting standard loads for small game and target shooting is that the handloader accustoms himself to light recoil and economical loads, thus permitting a great many more shots to be fired. He must bear in mind that the hard alloy bullet of the cast variety will not upset with low-pressure smokeless-powder reduced loads as will a much softer factory-swaged type. On low-pressure loads it is better to have a bullet too tight than too loose. One must also bear in mind that many of the light-weight small-caliber jacketed bullets have extremely soft jackets, thus permitting them to expand and fill grooves. Nearly any bullet, if it fits reasonably well, can, through experimenting, be made to shoot accurately with mid-range loads; but properly fitted bullets are more inclined to be uniform and more effective than the ill-fitting type.

Some handloaders insist on using an entirely different type of bullet for reduced loads—bullets which *look* different and thus will prevent the slightest mistakes of identification. Others see no necessity for this. If a shooter is careful in his loading and in his labeling of ammunition, there is no particular reason why full-charge and reduced loads should become mixed. Any shooter who is unable to keep his ammunition in such a way as to prevent these mistakes will do well to stay out of the handloading game. If you want your bullets to look different, you may make them so. Anyone who adopts this system very clearly classifies a bullet and limits its field of usefulness.

It should be kept in mind that certain reduced loads do not begin to fill the cartridge case with powder, and that it is possible to load double or even triple charges. With proper care in handloading and suitable inspection before the seating of the bullets, double charges should never occur. Slight variations in reduced loads involve no element of danger, but double charges, due to the high-speed burning characteristics of reduced-load powders, are inclined to run pressures to the danger point. In the lightest of loads it is advisable to elevate the muzzle before firing the shot. This runs the powder into the rear of the cartridge case, where it may readily be ignited by the primer. If the muzzle is pointed downward, in many cases a

hangfire, occasionally quite pronounced, will occur, and in no case will accuracy be up to par.

Extremely light loads with metal-jacketed bullets, particularly where the powder charge is not against the primer, may even result in a bullet's failing to leave the barrel. Under such conditions, removal of the bullet is not an extremely difficult proposition, since in all probability it is not swaged or upset into the grooves properly. In such a case use the flat end of a cleaning rod inserted from the muzzle, open the breech, and try to push the bullet out. Do this, if possible, by a steady pressure of the hand rather than by hammering. If it is necessary to hammer, use the heel of the hand first, then a wood mallet on the handle of your cleaning rod if the bullet refuses to start. One little turn, well worth considering, particularly where a bullet has progressed only six or eight inches into the barrel, is to insert the cleaning rod from the muzzle, bringing it into contact with the bullet, and then, holding the piece horizontally or even vertically, tap the end of the cleaning rod gently against the wall or on the floor. If care is taken, sufficient steady pressure can be brought to bear to push out the bullet without bending or springing the rod. Reduced loads are by no means the crude developments a few full-charge shooters are inclined to label them. The reduced load has its own place in the realm of handloading. It makes an all-round gun of your pet weapon.

There is another use for reduced loads which the handloader will not overlook—small game hunting with a "big" rifle or handgun. In the latter field, various big-bore handguns make excellent killers when loaded with mid-range target loads of the "wadcutter" family. Many tests conducted with these clearly place them far ahead of the .22 rimfire series in killing power, and at approximately the same cost. They are easy to handle, to load, and in the guns for which they are designed, the low recoil and noise reduction make for better shooting.

In the rifle group, hunting loads offer no end of experimental work. Years ago, when the author was a "one-gun" handloader, his favorite chuck and crow load in the .30/06 was a Winchester .32/20 soft-point 115-grain bullet loaded at about 1700 f.s. This was not a toy load—it would shoot through a telephone pole, and it would certainly anchor a chuck. That thin gilding-metal jacket with the generous exposure of soft point would insure mushrooming of that particular load at all ranges up to 200 yards. The exact load of #80 is not before me, but it was developed to fit my barrel, with the result that the short stubby bullet would do better than 1½ inch groups at 100 yards when properly handled.

A friend uses as his small-game load for the Springfield, the 80-grain Western hollow-point .32/20 with 50 grains of HiVel #3. Not exactly a reduced load, as the muzzle velocity is almost 3700 f.s. He said it was accurate and gave me ten loads. In my Springfield I shot five of them at 100 yards—and made a nine-inch group. The muzzle blast was bad, the load was noisy—and to me it was one on which I'd write "NG." Yet the chap who used them insisted that it was fine up to 100 yards—and he proved it by getting chucks consistently. . . . Others use Luger and Mauser pistol bullets in the Springfield. I've shot some fine 50- and 100-yard groups with the Luger bullet, but never had any success with the Mauser.

Reduced and mid-range loads make an all-round gun out of a one-purpose weapon. The various bullets will make the .30/06, for instance, suitable for indoor gallery work, outdoor short-range practice, squirrel hunting, varmint extermination, small-game hunting (differing from varmint shooting in that it is necessary to save meat or pelts); deer, and up to the largest of North American game—elk, moose, Kodiak bear. How many of these .30/06 loads can you *buy?*

Notes on Target Loads. Here are a few special notes on target loads of extreme importance to the handloader. The finest of accuracy, particularly at long ranges, is achieved with slow-fire shooting. Thus in slow-fire target work, load direct to the chamber instead of through the magazine. Such loading not only means minimum damage to the bullet in feeding, but also permits one to omit a crimp. Crimps are useful only on cast bullets, and then for magazine fire. The recoil will frequently change the seating depth of an uncrimped bullet, particularly if it remains in the magazine for several shots. In revolvers, uncrimped bullets frequently ride out of the case, jamming the gun and spilling the powder charge through the mechanism.

There is still another reason for "single-shot loading." This permits of any overall length of cartridge. For magazine fire, your cartridge must not exceed a certain maximum length. Some will not work well when short stubby bullets are used. But always the bullet should be loaded as far out of the case as is practical. Why? Simply because, if your bullet fits into the leade or throat of the rifling, it gets off to a much better start, with less mutilation, less strain on that important part of the rifling. The leade has a tremendous job to do. The bullet, clean and unmutilated, jumps from the

mouth of the shell, driven by the tremendous volume of gas at high pressure. It is forced into the bottom of the grooves, swaged into shape, and twisted sharply to start it rotating with the rifling. Naturally, the hot gases back of the bullet and much of the still burning charge of powder are driven into the rifling, as the bullet, moving down the bore, actually increases the length of the chamber. These gases reach their greatest heat and probably their highest pressure when the bullet is an inch or two down the barrel. (This has been proved through special laboratory apparatus that photographs the pressure curve by means of a Piezzo electric gauge, cathode-ray tubes, and camera equipment.) Thus this portion of the bore gets the roughest treatment from both the bullet and the blast of hot gas.

"Wear" in a rifled barrel is first noticed in the leade. And wear at this point is frequently a cause of inaccuracy. A few thousandths of an inch here, since it is on a taper about the same as the contour of the standard bullet nose, may necessitate a new overall length greater than previously used with the same bullet, if a good fit is desired. This may run to ⅛ inch or better.

One rifleman friend uses metal-jacketed bullets in his Springfield, and loads them at least ¹⁄₁₆ inch larger than the barrel will handle. To close the bolt requires some slight effort, as the bullet is seated the remainder of the distance by the closing motion. Withdrawal of a live cartridge clearly shows land marks on the metal jacket. Perhaps this is an extreme, yet it produced a couple of bench-rest two-inch groups—ten shots—at 200 yards for that chap when used with his ancient Winchester A-5 scope. If you load for target, get all you can out of your load. And remember this law:

Before you can take it out, you must put it in!

At Camp Perry's 1935 National Matches, the Wimbledon Cup battle saw many hand loads. The author saw one chap run his possible with 14 "V's," using his own loads. A tricky fish-tail wind, typical of Perry, cost him several V's, as it did other contestants. That shooter picks his long-range cases carefully, inspects every bullet, conducts all other operations as though he were to sell the cartridges for $1 each—and they do not fail him. I've never heard him offer an alibi. This rifleman always loads so his bullets just touch the leade.

Certain cast bullets will not work well if they have to jump a great distance from the mouth of the case. Many will deliver results even better if they are well seated into the rifling. Such loads should never be extracted once they have been seated, as the bullet frequently pulls out of the case neck, spilling powder in the chamber and action and necessitating a session with a cleaning rod to remove the bullet.

The target rifleman has many of these problems to solve for himself. Careful loading will frequently make a fine target specimen out of a worn or discarded barrel. He quickly learns that maximum power is not a requisite of target work, and that the loads well under the recommended maximums give better accuracy.

The reduced and mid-range field is the greatest for the experimental shooter and handloader.

XXVII

OBSOLETE BLACK POWDER AND FOREIGN CARTRIDGES

THERE are large numbers of foreign guns on the market today, many of them, of course, being of the so-called military variety and quite evidently World War relics. There was a time when these guns were classed as war souvenirs and kept among those items which one desires to save as such. During the past four or five years, however, many of the owners have lost their interest in war souvenirs and disposed of them to the younger generation. The new owners have remodeled their guns into sporters and target weapons, and having found that factory ammunition is expensive—particularly factory ammunition for foreign arms, which must be imported—they wish to reload if possible. Many of these imported foreign cartridges cost as much as 35 cents each, which, of course, is out of all reason in proportion to their actual value. No wonder the handloader is willing to go to unusual expense to be in a position to load for his gun.

In the first place, development of loads for these foreign cartridges, not readily available on the market, are makeshifts, no matter how you look at them. You must consider that maximum or full-charge loads, therefore, are out of the question, and that no attempt should be made to approach the original standard without suitable equipment. Accordingly, reloading for these guns resolves itself into reduced and mid-range charges. Of course you can import any primed shells or primers of the Berdan type from foreign countries if cost means nothing to you. This also applies to bullets. Usually, however, the problem is not one of bullets but of suitably fine shells to fit your chamber. Practically all foreign cartridges are of the so-called Berdan primer, and in this type of cartridge case the primer is nothing more or less than a percussion cap with no anvil. The anvil is part of the original punching of the cartridge-case primer pocket. A few of these made in Austria, Denmark, Switzerland, and so forth, use a single flash hole in the center much the same as the American makes. This flash hole comes up through the little tit or anvil crushed into the bottom of the primer pocket. In order to prevent its clogging, a "vee" groove is formed across the top of the anvil.

Decapping a Foreign Cartridge. Most of the foreign cartridges, however, have twin flash holes, one on either side of the anvil. This, of course, creates a major problem in decapping. Having twin flash holes, these cartridges do not need as large a flash hole as the American single-center hole, and it is doubtful if one could obtain a proper needle punch to go through these tiny orifices. The European handloader, in reloading his old shells, clamps the cartridge case in a special holder and by means of a "corkscrew-like device" runs a prong hook diagonally into the soft copper or brass cap and actually lifts it out of the pocket. It is possible to secure these tools in foreign countries, but I do not believe they are sold in America. If a Berdan primer is crimped into a cartridge case, and you have a supply of such cartridge cases, it is occasionally possible to put them to good use. The case may be filled with water and a wooden plug or bullet seated at the mouth to make a tight fit. The bullet is then given a smart blow with the hammer and the hydraulic pressure created will force the primer out of the pocket. At the same time experimenters frequently find that the blow will quite certainly force water from the neck of the cartridge case and a shower bath is likely to ensue.

Once the old primer is removed, comes the problem of endeavoring to reprime the shell. With some cartridge cases the American forms of Berdan primers can be used. Both Winchester and Remington manufacture a number of different sizes. It is best to measure your case accurately and order primers direct from the makers. Some cartridge cases can be altered by having the primer pockets carefully reamed to handle an American anvil-type primer, at the same time removing the old anvil from the primer pocket. Of course, one has the problem of decapping the primer of such a case if the twin flash holes are not plugged up and if the center flash hole is used in their place. An expert can braze these holes in the cartridge-case head and will do so on a small quantity of shells for a reasonable sum. On the other hand, it must be borne in mind that any brazed cases are likely to alter the primer pocket and may anneal the brass, making it dangerous to reload again. The flash hole

should also be drilled to an American standard or approximately .080 inch.

Before any attempt is made to handload foreign cartridges one should determine whether or not the proposition is worth while. Many foreign guns have poor barrels to start with, and the chambers are clumsy, awkward and oversize. Individual variations are such that no detail dimensions can be given. A lead slug pushed through the bore with a cleaning rod and then measured will determine the groove diameter which will enable one to select the bullet properly. One should also bear in mind that most foreign loading firms believe in using an undersize bullet. This frequently runs as much as .006 or .007 inch undersize—a practice which would be severely frowned upon in the United States.

A few of the foreign cartridges are, of course, manufactured in the United States. This greatly simplifies the problem, but in all types of cases one should choose a properly fitting bullet, selected not from the specifications of some handbook but as a direct result of personal measurements of one's own barrel diameter. Among the foreign rifle cartridges manufactured in this country are the 8-mm. Lebel, the .303 British, the 7.62-mm. Russian, the 8-mm. Mauser (7.9), many of the Mannlicher-Schoenauers, the .300 H. & H. Magnum, the .375 H. & H. Magnum, and of course the 9-mm. Mauser and the always popular 7-mm. Among the old foreign cartridges for which components can be purchased here are the .43 Spanish Mauser, the .43 Egyptian, the 11-mm. Mauser, and a number of handgun cartridges such as the 7.65-mm. Luger, the 9-mm. Luger, the 7.63 Mauser, the .455 Webley Mark II, the .455 Colt, the 5.5-mm. Velo Dog and similar specimens. A number of foreign cartridges, not sold in the United States, are manufactured by the Dominion Cartridge Company, Montreal, Canada, and it might be practical to obtain components from this firm, particularly since you can later use American primers in the reloaded shells. Duty, of course, is high, about 30% *ad valorem.*

Usually the handloader must resort to altering existing foreign cases. This primer proposition creates a serious problem. One practice recommended by several authorities is highly dangerous. *Do not drill out the flash holes to an extra large size!* This will give over-ignition, resulting in highly raised pressures which in many foreign rifles would be certain to prove disastrous. This suggestion is not based on guess work but is a direct result of tests conducted for the author by the Hercules Powder Company at its Experimental Station in Kenvil, New Jersey.

Fire-Fitting. Occasionally one can use American cartridge cases of a different caliber through the process of "fire-fitting." This is highly dangerous unless conducted in a slowly progressing manner. Cases a trifle too small or too short to fit the chamber are loaded laboriously with very light charges and then fired within the chamber of the rifle. Continued reloading and firing will expand the case so that it fits. Then *and not until then,* may the cases be used for mid-range target loads. Under no conditions should they be used for full charges. In this process of fire-fitting, the shooter must always wear glasses, as more or less gas is bound to leak back through the action, particularly if a case of hard brass splits under the strain.

This fire-fitting stunt was conducted by one shooter with excellent success in adapting a batch of 7.62-mm. Russian cartridge cases of American manufacture to the 8-mm. Mannlicher rifle. He put in very light loads and inserted them in the chamber of his gun. The first thing he discovered was that, while the cartridge would chamber, the bolt could not be closed upon it. Examination disclosed that the head of the Russian cartridge had a convex base and was slightly thicker than standard. This was dressed off with a file and the primer seated just below the surface of the dressed case head. Then the cartridge was chambered. About five or six light charges expanded it to fit the chamber properly.

Bullets for Foreign Barrels. Do not let the published ballistics of foreign cartridges lead you astray in your effort to duplicate them should you have suitable cases. For the most part these figures are obtained when the cartridges are shot in long military barrels, many of them greater than 31 inches in length. On the other hand, most of the sporting rifles to handle these cartridges have barrels running from 18 to 26 inches, and this means a velocity loss frequently as high as 450 foot-seconds.

It should also be borne in mind that many of these foreign rifles are chambered for the old-style blunt-nose bullets and in many cases have an extremely narrow throat. Even with carefully handloaded ammunition accuracy is difficult to obtain unless a proper selection of bullet is made. No general directions can be given here other than to state that each handloader should check his barrel carefully and experiment with different shapes of bullets either jacketed or cast in an effort to determine that which works best in his gun. Jacketed bullets may be difficult to secure but cast bullets are never hard to find. The Ideal people have a wide variety of obsolete moulds as well as the

standard sizes, and in this long list can be found a bullet which would work fairly well in almost any type of gun. If you do not care to purchase a mould for this experimental work, you can arrange with Lyman to obtain a hundred or two properly cast and lubricated bullets. Then, if they prove practical, comes the time to decide whether or not you wish to purchase a mould.

The question of resizing your bullets, if of the cast variety, is not very complicated. Makers of any reloading tool equipped to resize, can supply on order almost any size of die you may require. They will be glad to aid you. If you can secure a suitable bullet mould which casts approximately .010 too large, it is a simple matter, even in a hard alloy, to bring the bullets down to proper dimensions. If bullets are cast 1 to 10 or 1 to 15, it is best to run them through the resizing die twice, stepping down the .010 in two different stages. If they are of softer metal, no trouble will be experienced in using a single die.

If you have an old bullet mould which casts undersize, this can be increased in size with a little patience, if you desire to retain the same general shape of bullet. The process is really quite simple. Remove or open the sprue cutter, cast a lead slug in the mould using a flattened nail head in the center at the time the metal is run in. This will serve as a lap and can be sawed off with a hacksaw and used in a small hand twist drill. The bullet should then be coated with oil or water and an ordinary fine valve grinding compound smeared over its entire surface. The mould should then be closed on it but spaced open slightly at the blocks with a thick sheet of letter paper. The lap is then spun slowly, which will gradually enlarge the cavity. As this increases in size, the mould blocks can be closed down on it through elimination of the paper. It should be borne in mind that the lead lap will wear out much faster than the metal of the mould, and therefore it may be necessary to make several different laps. This job is a rather slow one but is well worth while if one desires to increase the size somewhat. At frequent intervals the mould should be washed free of all grinding compound, reheated, and a few trial bullets cast with it to be carefully measured. This is the only way one can properly determine what size he is getting. Even with calipers the inside measurements taken on a cold mould would be useless for comparison with the finished cast bullets from a properly heated one.

Obsolete and Black-Powder Cartridges. Many handloaders like to acquire an old-time gun to play around with reloading. There is still as much accuracy in an old .45/70, .32/40 or .38/55 as there ever was. Handloaders can bring out that accuracy with many of the obsolete black-powder cartridges, particularly as the .28/30 Stevens, the .25/20 Single Shot, the .40/72 and a few of those, are capable of finer accuracy than ever before with some of the modern powders, primers and bullets.

One should bear in mind that most of these old timers were designed for lead or lead-alloy bullets, and that the use of jacketed loads will create excessive wear on the soft rifling. Most of these barrels were rifled in steel about the equivalent in strength of the modern cold rolled, so they will not stand the pressures of smokeless powders even if they were capable of withstanding the wear and tear of the jacketed bullets.

For many of these old cartridges, with Du Pont Bulk Shotgun, Rifle Smokeless #1, Schuetzen, Gallery Rifle #75, and many of the similar obsolete and hard-to-locate powders, are extremely useful. These powders are never obsolete as long as one can aquire them, and occasionally old lots can be picked up in sporting-goods stores and supply houses. In the absence of these smokeless powders of low-pressure variety, semi-smokeless and black powders can be used to good advantage. Of course black powder is dirty to handle and rather messy on the gun, necessitating extensive water cleanings, but it is still capable of delivering excellent accuracy if properly handled. Ballard rifles are being picked up on the market today in excellent condition, and many a rifleman has been exceedingly proud of the development of handloads with the old-timers even in this modern age. If properly handled, the Ballard is capable of delivering Springfield accuracy up to 200 yards.

In many of the cases one finds odd-size primers necessitating that the pocket be altered in size and shape. The author does not recommend drilling out these pockets as do some other writers. It is much better to have a swage made and force them to the shape desired. The Schmidt primer-pocket swage intended for the .30/06 cartridge as a crimp remover is an excellent device for use in the old-timers. Any soft brass rifle case can have the pocket enlarged to the exact size necessary to handle modern primers such as the FA #70, the Remington #8½, or the Winchester #120.

An interesting and often overlooked source of supply is the professional cartridge collector. Charles Shattuck of Cherry Creek, New York, has long been a dealer in modern odd cartridges for collectors. He buys in huge quantities, usually in whatever amount he can acquire, and under nor-

mal conditions maintains a stock of more than 40,000 different cartridges. Very frequently he has some of the old-time Sharps, Ballard and similar cartridges in quantities sufficiently extensive to interest handloaders. Of course he deals these out to collectors for from 3 cents to 10 or 12 cents each, but when sold in quantity, the price is more within the range of customary new ammunition.

The Ideal Manufacturing Company, now owned by the Lyman Gunsight Corporation of Middlefield, Connecticut, also occasionally locates a few of the old Ideal Everlasting shells. Although these cases have been obsolete for a great many years, the manufacturers frequently have calls for them and are in a position to make up a batch at a reasonable price if the quantity is sufficiently large to warrant the necessary work. Such cartridge cases are, of course, hand-made out of solid rods rather than in the customary swaging system.

The handloader equipped with a small machine shop for metal work might be in a position to make up a few shells himself. If this is done, of course, the inner walls must be of the straight-bore type even in the bottle-neck cartridge, and the problem is quite complicated, yet still within the ability of a good workman. Swages can be made by many of the toolmakers should you care to pay the price, so that you can purchase shells slightly larger than necessary and swage them to the proper size and shape. Of course, this process is costly, as a great many shells are mutilated in the operation. Also the original cost of dies is rather extensive.

In the various magazines, from time to time, some of the larger supply houses announce sales of obsolete ammunition. Any houses known to handle this material would be well worth investigating, as they frequently have cartridges that they do not care to advertise. By writing them direct you will save yourself much research; a few postage stamps sent here and there may locate a reasonable supply of old-timers that can be used in your gun. If the primers have died, the bullets can be withdrawn, caked powder removed, the shells decapped and reprimed, and the shells can be completely reloaded.

In reloading these old-timers it is well to bear in mind that they are frequently susceptible to bullet tempers. If you can locate any old-timer who handloaded these now obsolete cartridges before 1900, he will be glad to give you interesting information. He will tell you how they experimented with various bullet alloys until they found one which fitted that particular barrel. Sometimes it was hard, again it was soft. But always a critical alloy gave the best results, and then only after they had experimented to discover it. You, too, may have to experiment. If you get an old-time rifle that is in good condition but still does not shoot accurately, the fault is yours, not the rifle's. Any gun which would shoot well twenty-five years ago and is in a condition equal to that of twenty-five years ago is capable of producing fully as good results today.

If you have one of these old-timers, you might care to experiment with paper-patch bullets described elsewhere in this book. If you have no bulk powder on hand, try Hercules Sharpshooter or Unique, but only in very light loads. It will be well to write directly to Hercules before attempting to load these powders. Semi-smokeless powder is always superior in performance to that of black if properly used. Of course this is dirty to handle and to shoot, but is not nearly so bad as black powder, particularly since the making of black powder today is practically a lost art, as the demand for it does not warrant the high degree of perfection that manufacturing standards once demanded.

Black-Powder Factory Loads. There was a time when practically the entire series of cartridges could be obtained factory-loaded with black powder. Today the survivors are rapidly falling by the wayside. As this is written (1937) a check of the arms and ammunition factory cartridges shows that the only black-powder loads available include the .22 Winchester Centerfire; the .25/20 Single-shot; the .25/20 Repeater; .32/20; .32/40; .38/55; .40/60/210; .43 Egyptian Mauser; 43 Spanish Mauser; .43 German Mauser (11-mm. Mauser); .45/60/300; .45/70/405; .45/75/350, and .50/70 Government. The entire list of rifle cartridges totals but fourteen.

In the handgun field the survival of the black powder cartridge is greater than in the rifle line. Here we find the .25/20 Repeater often used on handguns, particularly of foreign manufacture; the .32 Smith & Wesson; the .32 Smith & Wesson long; .32 Short Colt; .32 Long Colt; .32 Colt New Police, .32/20; .38 Smith & Wesson; .38 Smith & Wesson and Colt Special; .38 Short Colt; .38 Long Colt; .38 Colt New Police, .38/40; .41 Short Colt; .41 Long Colt; .44 Smith & Wesson American; .44 S. & W. Russian; .44 S. & W. Special; .44 Bulldog; .44 Webley; .44 Colt, .44/40; .45 Colt; .45 S. & W.; .45 Webley and .450 Revolver, a total of 26 cartridges. All but two or three of these are, however, available in smokeless-powder loads. Many of these old-timers can be stepped up in accuracy

to a point even superior to that of their early days.

If you reload these black-powder cartridges, be sure to wash your cases thoroughly as soon after firing as possible. If you can avoid it, do no resizing whatever, as black powder has a tendency to corrode the inside of the cartridge case and resizing merely causes this to flake off where it can drop into the case cavity and at the same time weaken the wall.

If you must use black powder, use the proper size for best results. For heavy rifle cartridges requiring 50 or more grains of powder, use granulation Fg or FFg; for lighter loads use FFFg; for handgun cartridges, FFFFg is practical. Most handgun shooters have trouble chiefly because they use too large a granulation of powder. The largest practical granulation is about FFFg. Really large cartridges, such as some of the old Sharps .50/95 and the .50/115 Bullard, the .45/70 Government, the .40/60, and the .45/60, work best with granulation about Fg.

A suggestion for loading these old cartridges comes from H. A. Donaldson of Little Falls, New York. Mr. Donaldson loads both black and smokeless powders quite heavily, and in a great many cases, experimenting with certain loads known to be safe, he uses more powder than the case will normally handle. His system of running this powder in is extremely interesting. First he uses a short length of four or five inches of brass rod which will just slip through the mouth of the case. A small funnel is built to fit the case neck, the powder poured in, and the rod inserted. This retards the flow of the powder somewhat. The case, of course, slowly fills up to the neck and the powder flows slightly into the long funnel neck. The rod is then lifted to permit this to settle as much as possible, whereupon it is replaced, serving as a weight. The head of the cartridge case is then tapped gently with a number of light blows, and this causes the powder, under the pressure of the rod, to settle considerably. It is just possible to get three or four more grains into almost any cartridge case. Unless you know your load thoroughly, however, this practice is of course dangerous.

There is a great field for experimental shooting and handloading with the old-timers. A friend of the author who should really know better, recently acquired a .45/100 Sharps, and with this big blunderbus has been endeavoring to develop *Gallery* loads for shooting in his rather spacious cellar. Certainly this man has other guns—several .22's and others far more suited for indoor work—yet he has decided that a truly accurate indoor handload can be developed with the old Sharps, and he is determined to stay with it until he gets the right combination of powder and bullet. He is having his fun, and that, after all, is the primary objective in this handloading game. If you don't like shooting, you won't like handloading. If you like to get the best out of your gun, you will want to experiment. Experimental work is practical, provided one exercises the proper safety precautions. Do not overload the old guns and they will do their best by you.

XXVIII

FOULING AND ITS CLEANING PROBLEMS

THERE never has been and probably never will be any excuse for complete neglect of the cleaning of a modern firearm. In this day and age arms and ammunition manufacturers insist in their advertising matter that you don't need to clean a gun if you use their "No-Foulem" primers. Perhaps they are right. The use of modern non-corrosive primers certainly simplifies the process of cleaning, *but cleaning is a necessity just the same,* all advertising to the contrary notwithstanding. A number of expert gunsmiths and barrel makers have written me to the effect that since the advent of non-corrosive priming they have replaced more ruined barrels than in the previous years when ammunition had poison primers and shooters understood this fact.

There are three very definite reasons for cleaning your gun bore after use: atmospheric and personal handling, which may create rust; primer and powder fouling; and finally a somewhat different sort of proposition—metal fouling. The handloader will find this in many of his experimental loadings, and it is well to know just what to do about the problem. Some of our shooters visualize metal fouling only on the basis of their own private experiences. This "metal fouling" consists of a thin smear of copper on the interior of the barrel; a smear which immediately looks bright if you merely wipe out the powder fouling with an oily rag. That is NOT metal fouling. Anyone who has shot the old cupro-nickel bullets, particularly those of wartime manufacture, may have fouled a barrel so badly that he could not consistently stay in the black at 200 yards prone. Looking through the bore, he found chunks of fouling in the form of flakes soldered or bonded to the rifling. He took the gun home and went at it with 28% Stronger Ammonia, Chloroil, Crystal Cleaner, or one of the other powder solvents of extremely potent nature. Of the various useful solvents, one of the most practical was 28% Stronger Ammonia, and it is well to mention the method of cleaning here and now, because the handloader in using up old batches of cupro-nickel bullets with certain loads will occasionally run into this type of fouling.

Method of Cleaning. The breech of the mechanism is stoppered up by means of a good clean rubber stopper. *Do not use wood or cork.* The barrel is slowly poured full of "Stronger Ammonia," available from drug stores and containing 28% gas. The so-called "household" ammonia is like warm milk in comparison. One good whiff of the "Stronger Ammonia" will cause an iron man to shed tears. It is perfectly safe to handle if care is taken, but its use requires a certain technique which with experimental variations may prove disastrous to a barrel. Before you use 28% Stronger Ammonia in your pet artillery, it is a good idea to take an old razor blade, put a drop or two on the polished steel, lay it aside for a few minutes, and then forget it. Don't wait a week, but come back in half an hour and look that steel over. You will notice an almost unbelievable amount of rust where the ammonia touched it and dried off. That same thing can happen inside your barrel, and no self-respecting shooter will feel very good about it. The answer is, "Be careful!" After plugging up the breech to prevent any liquid from leaking into the action, fill the barrel *completely full* of ammonia. This may be done by gently pouring it in, being very careful to see that the pouring *is* gentle; or it may be done with an ordinary eye-dropper by squirting it into the barrel until it is FILLED. See that there is no air space left at the top of the bore, then stand the gun up in the corner for fifteen or twenty minutes, not longer, whereupon you take the barrel into the bathroom, reverse it, and let the liquid run into the sink or wash bowl. It comes out a bright blue, said blue consisting of the copper dissolved from the cupro-nickel fouling. You immediately run a cleaning rod into the barrel from the muzzle, holding the muzzle *down* to keep the solution out of the action, and tap out the rubber stopper.

Working from the breech end, immediately shove a cleaning patch through the bore. This will wipe out the excess of ammonia and leave the patch colored a bright blue. Two or three more patches are used to make sure the bore is dry, whereupon you then cast your eagle eye down the rifling. If all visible metal fouling has disappeared the job is half completed. If it has been reduced, but you can still see little patches of the jacket material, run your rubber stopper back into the

chamber and repeat the process, filling the bore completely once more and permitting it to stand another twenty minutes. This is then emptied out, the stopper removed, and the bore rewiped and examined. When the metal fouling has disappeared, it is time to clean the gun. Remember what happened to your steel razor blade. No traces of ammonia can be permitted to remain in the barrel if you expect it to look dignified the next time you cast your eye through it. The best way ever determined as an after-cleaning method is the simple process of pouring a quart of boiling water through the rifled tube. A small tin funnel, its end properly shaped to enter the chamber, is most convenient for this work. The family bathtub is also useful, since you can rest the muzzle over the drain and thus hold the gun much steadier during the pouring process. The barrel, incidentally, should become altogether too hot for comfortable handling.

After the water has been run through the bore again, wipe it out. The heat in the barrel will complete the drying, and after it has cooled slightly, you can treat that barrel with any of the patented cleaning oils, cleaning solutions and other concoctions designed to take the pennies away from you; or you can use a light-bodied gun oil. Incidentally, the oils which this writer cares to recommend for the coating of the bore include Remington Gun Oil, Browning Gun Oil, Winchester Gun Oil, Savage Gun Oil, Riel & Fuller's "Anti-Rust," "Protecto-Bore," Ithaca Gun Oil, Verrell's "Gun Lover's Oil," and Nye Oil. There are other oils on the market and some of them may be good. Others, however, which are highly advertised, are as impractical as they could possibly be. One oil which has for many years been advertised as non-gumming, non-acid and non-this and non-that had a very marked acid reaction in chemical tests made by the writer. It has also some excellent gumming properties, as he has learned by examining many weapons in which this oil had been used exclusively. Furthermore, certain arms manufacturers who once recommended this oil have ceased to do so.

If you want a very good low-priced gun oil, experiment with ordinary engine oil of a body about SAE 20. This oil is really of high-grade quality—if you don't attempt to play with the grades sold by chain stores. For instance, a quart of the finest of Jenny, Quaker State, Shell, Mobiloil, Texaco, Wolf's Head or your particular pet brand, if of these better grades, would cost 35 cents, and while you may not care to pour 35-cent oil into your old Model "T," it is an excellent economy for firearms use. A quart of this high-grade oil can be broken up into small batches and distributed among your friends, and will come pretty close to supplying the neighborhood for life if used solely for guns. Firearms really require very little oil, all talk to the contrary notwithstanding. There is such a thing as overdoing anything. Another very high-grade oil, one probably superior to most of them, is the anti-freezing oil sold for use in electrical refrigerators. A small quantity of this can be used in any gun. It will not corrode and is reasonably free from gumming.

Gumming. This, by the way, is another subject of those polite fictions used widely by the chaps who prepare advertising copy for oil makers. There has never been an oil manufactured which would not gum somewhat. When you read an advertisement saying that a certain oil is absolutely free from gumming qualities, shove your tongue in your cheek, turn over the page and read the testimonials of how Mrs. Smith reduced 47 pounds in 10 days using cast-iron pills, and at the bottom of the same ad another testimonial from skinny Mr. Twiddlefingers who, by taking the same pills, added 11 pounds to his 105-stripped, in less than a week. If you believe everything you see in advertising, you might just as well assume that most of these oils are non-gumming—which they ain't.

It is well to understand what gumming actually is. Any oil, if permitted to stand in the sun and slowly cook, with the air carrying away the volatile fluids contained therein, will thicken up and is said to "gum." On the other hand, from the standpoint of the shooter, that isn't by any means all there is to gumming. An oil smeared on a thin steel plate and kept under proper conditions may still be wet and oily instead of sticky at the end of a six months' test; that oil may be said to be of "non-gumming" nature. At the same time, if you stir in a mixture of flour, of fine dust or débris such as powder fouling, into that same pure non-gumming oil, you gradually accumulate a solid or sticky mass which not only dries out to a hard unyielding surface, but also causes the oil to work out at the same time. Under these conditions your non-gumming oil becomes a gumming oil.

Not long ago a police chief laid three Service revolvers on the author's desk and asked him to find out what was the matter with them. He said they were not reliable. A dry firing test verified this. They did not function perfectly, either single or double action, anywhere from 3 to 15 shots, whereupon something would stick and they would refuse to cock. We stripped them down. All the interior parts which should have been bright

were painted a rusty brown. The guns had been in service for more than 20 years and had been shot but little. They had been well oiled with reasonable care by the officers to whom they had been issued, but these oils had dried out, leaving a thin brown smear over all metal parts. This kind of smear has absolutely no lubricating qualities. In fact, it is the exact opposite of a lubricant. Movement of the parts causes a sticking which is extremely inconvenient. In the aforesaid revolvers, that gum was so thoroughly dried that it could not be wiped off, even after a three-hour soaking in high-test gasoline. It was necessary to put each part on a buffing wheel and burn off the débris. Mind you, there was no rust in this, merely an accumulation of oil, plus a little dust, plus the natural oxidation which time and air bring about on all elements.

To prevent oil from gumming, use as little as possible and wipe all oiled parts at frequent intervals. This doesn't necessarily mean a stripping of the gun every time you shoot it. It is a good idea, however, to strip your guns at least once a year, if you know them well enough, whether they have been used or not. Clean all parts by soaking in gasoline and then wipe with a clean dry rag, and reassemble. Use oil very sparingly. The more you use, the greater the tendency to collect dust, dirt, powder fouling—with the consequent reaction which forms gum. If you have a small part working in a channel perfectly smooth with a clearance of a couple of thousandths of an inch, you can't shovel that channel full of gritty débris and still expect the small part to work smoothly in it. Just a simple law of mechanics.

This Hot-Water Cleaning. Great-Granpaw had a custom-built rifle. True, it was only a flintlock and today might bring in the used market some five or six dollars as an antique; nevertheless, it was a custom-built rifle. It cost good coin in those days. The barrels were laboriously made by hand, the lock work was either handmade or imported by some small gunsmith who then hand-fitted it to the barrel and stock to meet his particular requirements, and, all in all, it was a rather expensive proposition. Perhaps Great-Granpaw went in for the old-fashioned turkey shoots, perhaps he was just a hunter. Anyway, he used his gun, used it frequently, *and used it well.* Result was, Great-Granpaw burned a great deal of soft coal in the old smokestick and the gun still came up smiling, despite the fact that its barrel was made of nothing but pure soft iron, not nickel steel, Winchester Proof steel or Ordnance steel as it would be today.

The secret of this long life was proper cleaning. Great-Granpaw couldn't go down to the store and buy himself a bottle of Hoppe's #9 or Browning's Powder Solvent or any of the other concoctions for which they nick you twenty-five or thirty cents. Instead, he went out to the well, dragged up a bucket of water, heated it on the kitchen range—not by the process of turning on gas or flipping an electric switch, but by the old-fashioned method of whittling up perfectly good trees with an axe, thinning them down to proper dimensions, and pushing them into the old cast-iron stove. When Great-Granpaw heated water, he worked for it. When he got through heating, he used it well, not skimpingly by moistening a single cleaning patch, but by careful manipulation of that water to cleanse the whole bore thoroughly. After he graduated from flintlock to percussion cap with the modern times coming on, he found that it required *particular* attention after firing to prevent rusting and corrosion. Being an energetic man and also rather frugal, he managed to heat a little bit more water and scrubbed a bit more thoroughly. He never dunked the gun, realizing that the hot water poured into the wooden parts might cause warpage. Great-Granpaw was intelligent.

Then came Granpaw—and Dad. The flintlock became obsolete. In its place came the percussion gun and the breechloader. Pop played around with the old black-powder paper and linen cartridges, finally getting himself one of those new-fangled "ca'tri'ge guns." He soon found that this, too, required cleaning . . . and then came smokeless powder. Pop still stuck to his cleaning because he found that, while smokeless powder simplified the job, it would by no means eliminate the necessity for it. About that time a lot of these chaps who saw a chance now and then to dig up a few extra dollars began to bring out these new-fangled cleaning solutions. These didn't go over so well with Dad. He still stuck to his old water-cure, and his guns stayed in good condition. He experimented from time to time, but would never switch entirely.

Now comes our own generation. We read the ads of the makers of cleaning solutions; they sound excellent, so we begin to use them. We find that they greatly simplify cleaning (that laborious task was never appreciated by either Dad, Grandad or Great-Grandad), and so we commence to tone down on this very important feature of shooting. Since the turn of the century, there have been many thousand times as many barrels ruined through neglect as there have been "shot out"—actually shot out through excessive use. The cause of this damage is laziness, pure and simple; im-

proper cleaning; too much faith in the claims of "powder solvent" manufacturers. We depend too much on those solvents, and we ruin our barrels. Then we buy new ones and repeat the process.

Shortly after the close of the war, the Department of the Interior Bureau of Mines for some reason or other became interested in the problems of the Ordnance Department, which complained that too many of its "properly cleaned" firearms had gone and eaten themselves away. "Corrosion," the Ordnance men said, "appears to be taking place despite proper cleaning and coating of the bore with oil or grease." Why? So the Bureau of Mines began investigations which culminated in 1922 with the publication of the now out-of-print Technical Paper #188 entitled "Corrosion Under Oil Films with Special Reference to the Cause and Prevention of the After-Corrosion of Firearms," by Wilbur J. Huff.

I don't know who Mr. Huff is, but he apparently had an unlimited supply of laboratory equipment at his disposal to aid him in his investigations. Great-Granpaw, however, could have explained the whole thing to him in fifteen seconds. "Your bar'l," the old gent would have said, "won't rust on ye if ye clean it afore ye ayl it," and with that he would have considered the explanation complete.

It is indeed unfortunate that Technical Paper #188 cannot be reprinted by the Bureau of Mines. The tests were refreshingly complete. They showed that modern smokeless powder apparently left a non-corrosive residue, particularly in the so-called "modern formulas," so they began to investigate the primers. They fired normal charges in special rifles, using instead of a regular primer a means of electric ignition. No corrosion in the barrel. Then they tried primers. To sum up, they found that the so-called "chlorate primer," which until the advent of non-corrosive priming had been practically the accepted formula with all ammunition manufacturers, was leaving potassium chloride in minute quantities distributed throughout the interior surface of the barrel. A few beginners may not understand what this means. The old-timers will, of course, pardon the repetition of what is not news to them.

Potassium chloride is a mineral salt almost identical in appearance with a less expensive mineral salt chemically known as *sodium* chloride. This latter, in case you are interested, is nothing but ordinary table salt such as is used to season the food you eat each day. The chemical properties of potassium chloride are such that one desiring to experiment with it can get almost the same results from ordinary table salt. If you will take an ordinary razor blade, polish its surface to free it from oil or grease, and then place a pinch or two of ordinary dry table salt on its shining flat surface, you will notice that within a day or two rust begins to form in the vicinity of the salt grains. Why? The answer is very simple. Salt is extremely hygroscopic. It attracts moisture from the atmosphere. The result is a very concentrated "brine solution" which eats rapidly into the steel.

This same action occurs within the barrel of your pet rifle if you leave the salts distributed throughout the bore after firing. You cannot run a dry rag or even an oily one through it and wipe these out. Your metal is porous. Even though originally it was perfectly smooth, the act of rifling, while appearing to make a perfectly smooth surface, tears or "plows" out the chips of metal, leaving tiny microscopic craters or pores. The high pressure generated by the burning gases or products of powder combustion forces the minute grains of potassium chloride, which is also a product of *primer combustion*, into these pores, and no amount of wiping can possibly dig down to the bottom to get them out. However, as ordinary table salt can be removed from anything through the application of water to dissolve and wash it away, so the application of hot water will dissolve this salt from the pores of the barrel metal. As a result of these extensive experiments, which occupied several years and are described in detail in this excellent Technical Paper, the Bureau of Mines recommended that instead of using prepared cleaning fluids on military rifles they be cleaned with hot water where available and cold water if the hot cannot be obtained. This is quite interesting. It turns back the wheels of progress approximately 100 years. Great-Granpaw may not have been a chemist, and he may have used black powder, but he found out quite early that plain, ordinary heated water was the best medicine he could give Old Betsey.

Came non-corrosive priming and the manufacturers burst forth with their enormous claims concerning the elimination forever of the necessity for cleaning your pet barrel. Well, maybe they're right. But we blushingly call your attention again to the previous remark made by gunsmiths who claim that modern priming has brought a boom to their rebarreling business because it has dulled the sense of responsibility of shooters.

Assume, if you will, that modern non-corrosive priming having no potassium chlorate in its formula cannot generate and deposit in the barrel that extremely harmful salt known as potassium chloride. What, then, could possibly cause the rusting

of your barrel? Again we refer you to those old razor blades. (Incidentally, if you will save these things, which you have been trying so long to dispose of in a safe manner, you will find them extremely useful for numerous tests.) Place one of them outdoors, lay it on something where moisture cannot get to it. Let the sun beat down on it. Keep it protected from normal rain. Will it remain continually bright? It should, shouldn't it? The answer could well be borrowed from the small boy who, feeling very sarcastic about something, replies briefly, "Oh, yeah?" There's bound to be moisture in any normal atmosphere, and moisture on any steel except stainless steel can cause rust. Even on stainless steel it will cause a form of tarnishing which is unlovely to behold. The net result is that if you want to keep your barrel in perfect condition, you must learn to take care of it.

Metal Fouling. There is still another thing that the non-corrosive primer makers neglect to mention—the effect of metal fouling. Metal fouling will occur with any jacketed bullet and with some cast varieties. To ask a primer to cure metal fouling ills is like asking your grocer to repair your car. It's not quite up his alley. Metal fouling is in two distinct forms—the thin smear from copper-jacketed bullets and the patchy type usually associated with cupro-nickel. The shooter, therefore, feels that if he never uses cupro-nickel bullets he has eliminated the problem of metal fouling. Perhaps—and perhaps not. It was back in 1927 at the National Matches that I saw the worst case of metal fouling it has ever been my privilege to behold.

This fouling was caused by Frankford Arsenal Mark I ammunition using a 172-grain 9° boat-tail gilding-metal-jacketed bullet at 2725 f.s. The actual shooting which caused the trouble had, of course, a preface, and I will state it here, not as an alibi of the score I turned in, but merely as a fact. The gun in question, a 1927 National Match Springfield, was, of course, in perfect condition, having been issued new at the Matches. It had been in constant use throughout the Small Arms Firing School and a number of NRA Matches which preceded the National Matches. It is safe to say that I had fired that gun at least 1000 times. We had been issued 1927 National Match ammunition but there was a tremendous turnout at the Matches that year, and before the actual National Team Matches began, the entire supply of Match ammunition became exhausted, and they began to issue us 1926 Mark I material, a slightly higher velocity load than the National Match offering.

They gave us a considerable amount of practice with this new ammunition to enable us to correct our sighting at ranges varying from 200 to 1000 yards, and this in itself was a job. With it, and this rifle, I managed to gather in a few pieces of brass offered by the National Rifle Association in "Skidoo" matches—qualifications in Rifle Marksmanship at 200, 600 and 1000 yards. Only a few days before the particular day in question, ammunition bearing the same lot number had been issued to me for a requalification at 1000 yards, which rated me two or three bars with 50 x 50, 49 x 50 and 49 x 50 at that range; and then came the day of the team match. When our team went to the firing line, I consulted previous sighting data, hooked the micrometer on the rear sight, checked it up according to notes, studied wind, mirage and all the other problems of the long-range rifleman, and eased off the trigger. The pits telephoned back a 7 o'clock bull, and up went the proper marking disc. The gun was reloaded and the routine checks of wind, mirage, etc., were again made. With everything favorable, another shot was touched off; this time the pit boys waved the red flag.

To make a long story short, the following four shots were definitely scored as misses—missing the target completely and going the Lord knows where. They may have gone sky high and eventually dropped into Lake Erie; they may have gone down into the hard-packed clay long before they arrived at the butts. At least we had the satisfaction of no marker checking up a hit on the wrong target. The remainder of the string scored the lowest possible marks. One was at 5 o'clock outside the rings in the lower corner of the target frame, another one was almost directly opposite outside the rings at the top of the frame, and still another was a low three. The score, naturally, ruined my average in shooting. What was more peculiar was the fact that every shot was a perfect hold, no flinching, and what happened was absolutely unaccountable. The ten-shot string was finished but might just as well not have been fired, so far as amounting to anything was concerned.

Securing the permission of the team captain to return to camp, we went back to the tent, removed the bolt, and endeavored to run a cleaning rod and patch through the barrel. The patch went into the breech approximately two inches beyond the mouth of the chamber, and stuck there; an effort to shove it further resulted in a punctured patch, which required much work to remove it. We cut a patch about half size and tried that. Never before or since have we seen such a tremendous mass of metal fouling in a barrel. There were big gobs

and flakes of it, some of it curling up badly and appearing almost to choke the bore down to less than .22 caliber. We immediately returned to the firing point, showed the barrel to the team captain and range officer, and they immediately volunteered to strike off the original score and permit it to be re-shot. However, the idea of shooting a strange rifle in a match had never appealed to me, so I permitted the score to stand, the appearance of the barrel alone serving as an alibi for the poorest piece of shooting done during the Matches.

Back at camp we proceeded to completely wear down two new brass bristle-brushes in an effort to scrub out that fouling. No go! We got a lot of it, but there still remained a worse dose than I had ever seen, even with cupro-nickel. So I hiked over to Commercial Row and turned the weapon over to Paddy O'Hare to experiment with. "Sure," said Paddy, "and I have seen plenty of metal fouling with copper jackets, but I never saw nothing like that!" And he proceeded to clean it for us after much work with Hoppe's #9 and later Chloroil. That afternoon we shot it again. It performed in accordance with its previous excellence.

Leading can seriously injure the accuracy of any gun. The above recovered revolver bullets were shot from a badly leaded bore

What had caused the trouble? Quite possibly an abnormally soft bullet which had stripped in passing through the bore, thus plugging grooves with chunks of copper. This, of course, would account for the first mass. Following shots, instead of wiping out the fouling, merely packed it down, possibly adding to it through the abrasive action of fouling against jacket surface. It is quite possible that succeeding jackets, although in perfect condition, were thrown out of balance through the mutilation in passing over the previously deposited lumps. This example is not extended as a boast or an alibi. We would much rather forget shooting a score such as we did and letting the team down in that fashion. It is pointed out to show that metal fouling can occur *with any form of bullet jacket.*

Al Woodworth of Springfield Armory suggests that it is even wise to remove the thin coppery smear one finds in his barrel after using gilding-metal jackets. This is not a troublesome fouling, and is usually ignored, as it cannot be seen in looking through the barrel. To find it, one must look into the muzzle from an angle, whereupon he notices a trace of copper, more in the form of a tint than an actual fouling, smeared the length of the bore. Usually this will cause no trouble, yet in the finest of target barrels it can, under certain atmospheric conditions, create an electrolytic action and roughen the bore surface beneath the smear. Particularly is this true when corrosive primers are used. Certain formulas of non-corrosive mixtures can do it. Ammonia doping is rarely necessary with this type of fouling—most of the prepared solutions similar to Hoppe's #9 will do the job quickly and well.

Keeping a Gun Clean. After cleaning a barrel with water, coat it with oil, but do not use the so-called "anti-rust" ropes, as they are inclined to evaporate the oil and absorb moisture from the air. In theory they are excellent. In practice, they are not so hot. The best way to leave your barrel after cleaning is to coat it with a light oil. Riel & Fuller's Anti-Rust is excellent despite its awful smell. You coat your metal with it, and the solvent dries out, leaving a wax-like coating which very effectively prevents rust.

Another product which thoroughly and effectively protects gun barrels and other metals from rust and corrosion is RIG, otherwise known as Rust Inhibiting Grease. RIG is a development of the RIG Products Company, now located (1948) in Oregon 2, Illinois. The firm is headed by Russell, Wiles, Jr., noted shooter.

As previously stated throughout the above suggestions, it is necessary first to clean your guns and have them in perfect condition before the application of oil and grease, if true protection is desired. RIG, on the other hand, offers an entirely different type of protection. A good way of testing this is to use safety razor blades and apply a perspiring finger tip to the blades after they have been thoroughly cleaned in boiling water. Then, once the finger marks have dried, coat one blade so handled with ordinary oil and the other with RIG, and place them both where they will be exposed to the elements. You will notice that, under ordinary oil, corrosion will begin after a few days. Under RIG there apparently is no change after two or three weeks of exposure.

RIG is neither an oil nor a grease. It is, in fact, a semi-grease which is sufficiently fluid at room

temperatures to penetrate fouling and seal itself to the steel. It will not harden, crack, peel, or run off. It does not appear to be a powder solvent and will not attack, discolor, or oxidize various metals. It is light in color and all tests the author has made indicate that it is absolutely acid free. If you put it in a clean barrel and leave it for three or four months, when wiped out it will still be clean, which is something we have been unable to say about a great many of the oils on the market.

In use, it is not necessary to clean your barrel thoroughly even after using corrosive primers. Merely coat a patch with this semi-grease and swab out the barrel a single time. This is especially valuable as a protection when Lesmok or semi-smokeless powders are used.

The author should like to caution handloaders who insist on using Frankford Arsenal primers, hence depending 100% upon RIG. A great many tests have verified the prediction that, under reasonable humidity conditions, RIG will protect a barrel completely for at least three weeks when put away uncleaned except for running a single patch through the bore. If you intend to put your barrel away for a longer period, be sure to clean it by the hot-water method. If the gun is in use each week or every other week, it is not necessary to go to this length. When non-corrosive primers are used, a single application of RIG will protect the barrel indefinitely.

Incidentally, this material is fully as useful on fine tools, micrometers, dies, gauges and other equipment of the handloader. It is not necessary to drench small tools with this material to get 100% protection. Merely coat a cleaning patch lightly with RIG and wipe over the bright metal. When it is next used, a clean cloth will take off enough of this so that the equipment can be handled without soiling the fingers.

If you intend to lay your barrel away for any length of time, coat it with a slightly heavier-bodied oil than standard. There is very little necessity for grease in this day and age. The best way is to use a heavy oil carefully rubbed into the barrel by the use of a medium-fitting patch, and then inspect your barrel at the end of a couple of months. The process doesn't take a great deal of time, and it is a simple matter to wipe out the barrel with a dry patch and re-oil it. Grease is a horse of a different color. If you put it in, you get a messy job; it gets into all parts of the action and gums things up, requiring half a day to remove it.

Any of the so-called "powder solvents" are excellent to use in a barrel if non-corrosive priming is used. They should be accompanied, however, by a vigorous scrubbing with plenty of cleaning patches made of ordinary cotton flannel, sometimes called "Canton flannel." Do not be stingy with these patches. Be sure your cleaning rod fits properly. A brass rod may be practical, but this author has thrown away too many of them to see any advantage in their use whatever. A jointed steel rod is useful in the rifleman's kit, but here its practical use ends. A solid one-piece steel rod is by far the best for home use. It is always set up, it has no joints to work loose, and it is not as likely to develop kinks. Keep it clean. A simple method of cleaning is to take the oily patch with which you completed the swabbing of the barrel, wrap it around the rod, and gently polish. The process takes but an instant. Use brass bristle-brushes regularly.

A .45-caliber brush can be used until it is worn down so that it no longer functions properly in a .45-caliber barrel. The energetic shooter can give it additional life by putting a slight twist in its brass backbone, thus causing the bristles to bear on the outside of the twist. By rebending from time to time considerable extra life can be drawn from it, and in many cases it can then be relegated to use in .38-caliber handguns or rifles instead of being totally discarded. By the same token, .38-caliber brushes can be used in .32 and 8-mm. arms and gradually stepped down to the smaller bores, reducing it until suitable for 7-mm. or .270 Winchester barrels. On occasion they can be used in .25 calibers. The practical rifleman never discards these brushes. There is always some use for a brush even after it is battered practically beyond repair.

Keep your barrel clean. It is one of the fundamentals of successful handloading. You can do all sorts of tricks with handloaded ammunition and your gun will still remain in good condition if it is properly cleaned within a reasonable time after firing. In the old days of corrosive priming, the author could never sleep nights if a gun he had fired during the day had been left uncleaned. Today, with modern priming, said gun is occasionally neglected overnight, *but never over twenty-four hours.* If the gun needs cleaning, the more prompt the attention, the more positive will be the results Take no chances!

Leading. Another form of metal fouling, requiring an entirely different form of treatment, is leading. This is caused by lead and lead-alloy bullets, both in rifles and in handguns. In rifles it can occur in the throat or leade only, or it may be distributed throughout the bore. In a revolver it

usually is found in the cone of the barrel—the rear end of the barrel which is coned or funneled to catch and swage the bullet as it jumps from the cylinder into the rifling. On occasion it is smeared throughout the barrel, and frequently it is found in the throat of the cylinder.

What causes leading? This author would like to know. Some who pose as authorities insist that it is a simple case of wrong bullet alloy. Perhaps. Not knowing, the author will not dispute this. And yet many factory loads will lead a barrel. Again the experts answer it by saying that said barrel is probably rusted, pitted, or very rough. Well, I've seen new barrels on new guns, and barrels lapped at the factory in the final finishing, which would lead badly with certain loads of factory fodder. Why? *¿Quien sabe?* I don't. Leading is a problem which, in *all* its phases, has not as yet been properly analyzed.

Generally speaking, however, leading is caused by an alloy bullet that is shot dry, with improper lubricant, or driven at too high a velocity. Lubrication may be insufficient or of the wrong kind—certain handgun bullets with narrow grease grooves are great offenders in this respect—or one may occasionally forget to lubricate at all. I have seen this done by experts who certainly knew better; they were using dry bullets of lead alloys, which, when shot, usually leave much of their surface smeared over the interior of the barrel. If a bullet is shot at too high a velocity, it will strip—shoot straight through the barrel without "taking the rifling." Thus the grooves fill up with bullet metal scraped from the bearing surface of the bullet, which is too lazy to spin. The answer, with a bullet of this nature, is to use a harder alloy.

When you accumulate leading, you lose all semblance of accuracy. The only remedy is to remove it completely. How? Wiping will not do it. You have to work. Brass bristle-brushes are very good for the job. If they will not take it—and in extreme cases they will not—use mercury. A wood plug is inserted in the barrel, some mercury poured in, and a finger placed over the other end of the barrel. Slowly roll the mercury from one end to the other, turning the barrel to expose the entire inside surface to the liquid metal. The mercury will amalgamate with the lead. After a few minutes, pour out and save the quicksilver, and finish cleaning with a brass brush, followed by cleaning solutions. Occasionally the mercury treatment may need to be repeated several times to remove all fouling.

Keep your barrel smooth. Rough barrels sandpaper the lead particles from the surface of a bullet, and succeeding shots do likewise, the leading piling up so that after a few shots the bullets will keyhole or travel sidewise, even at short distances. If you find that you can't use any combination of bullet shape and alloy, discard the barrel or switch to jacketed bullets. Usually, however, experimentation with a barrel will produce a non-leading load. Just look for it. And always promptly remove all signs of bullet fouling, whether from lead or jacketed bullets.

The .357 Magnum revolver brought up another fouling problem when it made its appearance in June 1935. Factory ammunition, then loaded only by Winchester, and recently added as a standard number of the line of all commercial manufacturers, created serious leading problems. Numerous tests have been conducted with new barrels, indicating unmistakable thorough leading or bullet fouling after about two cylinders of cartridges—twelve shots. This fouling would continue to accumulate slightly, but still maintain its thin patchy smear in all grooves and lands of the barrel for the entire length.

Despite numerous experiments and tests made by the Winchester laboratories, leading continued to be a major fault of that cartridge, and for a year it was accepted as inevitable by the makers both of the revolver and of the ammunition. This fouling did not seem to injure accuracy very seriously, as it was more or less thin. Therefore, they contended, it did little harm.

No self-respecting gun bug likes to look through his barrel and find it smeared from breech to muzzle with lead. Accordingly, the author endeavored to run this problem to earth and secured the cooperation of Colonel Douglas B. Wesson, vice-president of Smith & Wesson, and his staff of assistants; Merton A. Robinson, ballistic engineer of Winchester, and his staff; L. C. Weldin, ballistic engineer of Hercules, and the entire Experiment Station crew; plus cooperation extended by the Acheson Colloids Corporation; and W. A. Lamb of the Industrial Products Company.

First we tried to solve the leading problem by changing the bullet alloy. "The high velocity never before achieved is responsible for this fouling" was the accepted alibi. If velocity was the answer, a harder bullet should have solved the problem. Accordingly, we played with all alloys of lead and tin from 8 to 1 through to 30 to 1. There appeared to be little difference in the fouling from any of these alloys, indicating that temper of the bullet was not the answer. We then switched to lead and antimony alloys such as are used today by the majority of commercial ammu-

nition manufacturers. Again, we went down through the line from too hard to too soft: it had no effect on the fouling.

Lubrication seemed to be the answer. Accordingly we tackled it from that angle. Numerous experimental loads were developed, and in these full-charge offerings—some of them running even higher in velocity than the factory standard of 1510 f.s.—were backed by an ordinary grease wad such as we had been using in high-velocity rifle loadings. Immediately all traces of leading disappeared. With these high-velocity loadings, it was found advisable to seat the bullet slightly farther out of the case to compensate for the thickness of the grease wad, whereupon normal pressures and velocities were recorded, both at Hercules Experiment Station and at the Winchester laboratories.

The problem had apparently been successfully solved, indicating that grease wads would eliminate leading. At the same time these grease wads clearly showed—from machine-rest groups fired by the hundred, with handloads by the author and in special barrels at the Smith & Wesson factory—a degree of accuracy that left nothing to be desired. Colonel Wesson ran several hundred handloads through barrels in an effort to check them for leading. The barrels were then removed and shipped out to me for detailed examination. Reports in my files, together with the original barrels, clearly show that grease wads eliminate leading 100%. J. Bushnell Smith, of Middlebury, Vermont, also ran several thousand full-charge handloads through his own .357 Magnum, backing the bullets with grease wads, and reported absolute freedom from leading. My own personal gun stood more than 2000 different handloads and failed to show traces of leading.

Experimental work done by Smith was with cast bullets of his own manufacture. What experimental work I did through the cooperation of Smith & Wesson, Winchester, Hercules, and others was *for the most part* conducted with standard Winchester factory bullets. Other tests with cast bullets verified the findings of Smith, and many tests with these were run, both for leading and for accuracy, at the Smith & Wesson factory.

Colloidal Graphite. If grease wads could solve the fouling problem, it evidently was a matter of lubrication, and working on this theory, the author experimented extensively with various bullet lubricants. Ordinary material supplied directly to the bullet, and used without the benefit of a grease wad, failed to produce desired results when high-velocity and high-pressure loading (35,000 to 38,000 pounds) was used. Accordingly we undertook experimental work with colloidal graphite. The final material developed by Mr. W. A. Lamb is known as "Sharpe's Formula No. 2" and consists of 4 drams Oildag, 2 drams castor oil, 4 drams beeswax, 12 drams Japan wax, and 1 dram petrolatum. Experimental work showed that this material can be made either soft or hard, by controlling the blending time in the laboratory. Therefore, it was not found necessary to change the formula appreciably to achieve the desired consistency. This material is now available in stick form for use in any of the standard pressure lubricating machines.

Applied directly to standard Winchester factory bullets in the Star sizer and lubricator, numerous high-velocity loads were fired in various barrels for leading tests, and here again the fouling problem seemed to be completely eliminated. This lubricant costs about one-third more than the standard prepared bullet lubricant, but for those seeking an end to the fouling problem, it clearly holds the answer.

All machine-rest accuracy tests made at Smith & Wesson were conducted with handloaded .357 Magnum cartridges in which the powder charge was measured rather than being weighed, in an effort to closely approximate the results expected from average ammunition.

Sample figures for consecutive targets run as follows: Barrel D, Winchester 158-grain bullet, Sharpe Colloidal Lubricant No. 2, six-shot groups in every case, one shot being fired from each cylinder, 3/8 x 3/4 inch horizontal, 5/16 x 15/16 horizontal, 9/16 x 3/4 inch horizontal, 3/4 x 1/2 inch horizontal, 9/16 x 3/8 inch vertical, 13/16 x 1/2 inch vertical, 3/4 x 9/16 inch vertical, 7/8 x 3/4 inch vertical, 9/16 x 1 inch horizontal, 15/16 x 9/16 vertical. All measurements center to center of widest bullet holes in vertical and horizontal plane. One target with forty-two consecutive shots ran 1 15/16 x 1 1/8 inches vertical, indicating that the gun was bedding into the machine rest. One hundred and two consecutive shots ran 2 1/8 x 1 1/8 vertical, again indicating that the gun was bedding into the machine rest, as successive shots kept getting lower and lower.

Barrel E, standard Winchester 158-grain bullet. Winchester lubricant backed by grease wad Donaldson formula. Target 3/4 x 3/4 inch, 7/8 x 9/16 inch vertical, 13/16 x 3/4 inch vertical, 3/4 x 11/16 inch vertical, 5/8 x 13/16 inch horizontal, 5/8 x 1/8 vertical, 1 1/8 x 1/2 inch vertical, 13/16 x 7/16 inch vertical, 5/8 x 1/8 inch vertical, and so forth. Another forty-two consecutive-shot (seven full cylinders) showed a group size of 1 3/16 x 1 inch vertical. Another target containing 102 consecutive shots

showed a group size of 1¾ x 1½ inches vertical.

Barrel F, 146-grain Sharpe hollow-point single groove. Bullet cast by H. Guy Loverin, Lancaster, Massachusetts; alloy 1 to 20 lead and tin, Ideal lubricant. Donaldson formula grease wad back of bullet. The following targets show that the hollow-point bullet in handguns is accurate at normal handgun ranges. Consecutive targets run as follows: ⅜ x ¼ inch vertical, ¾ x 5/16 inch vertical, ½ x ⅜ inch horizontal, ¼ x 9/16 inch horizontal, ¾ x 7/16 inch vertical, ½ x ⅜ inch horizontal, ⅜ x ⅜ inch vertical, ½ x ⅜ inch vertical, ⅝ x ⅜. Another forty-two shot group showed remarkable accuracy, entire group size measuring ⅞ x ⅜ inch vertical. For comparison's sake on the twenty-yard target, this particular group would score 420 x 420, with but a single shot leaking out less than 1/16 inch beyond the ten-ring. Following this, 100 consecutive shots were fired and registered a group size of 1¾ x 1⅜ inches vertical. A three-inch stack of machine-rest test targets properly numbered is in the author's files and indicates similar results.

It will therefore be seen that leading can be eliminated from handgun loads in two very definite ways—through the use of grease back of the bullet, and by application of a lubricant containing colloidal graphite in the conventional lubricating grooves.

The fouling problem will confront the handloader from time to time. Many of the problems can be solved by means of diligent application and intelligent analysis of the case at hand.

After study of the detailed reports Mr. Weldin writes from the Hercules Experiment Station: "It is most convincing to me that objectionable leading can be eliminated and controlled by the proper lubricant on the bullet."

XXIX

HANDGUN AMMUNITION

SOME of the most interesting problems in the entire handloading field occur with handgun ammunition. Many experimenters who spend hours turning out precision rifle loads will carelessly throw together an assortment of primers, brass cases, bullets and powder and wonder why they do not produce good handgun loads. This type of ammunition should receive as much careful thought as any other form of handloading. The most practical thing about modern handgun cartridges is the comparative ease with which they may be handloaded. Only half understanding the problems arising, many chaps rush in carelessly, with the result that more guns are wrecked at the present time than one would care to recount.

The real trouble with loading for handguns is not lack of skill on the part of the operator but his failure to familiarize himself with the problems arising. He should learn the particular calibers with which he is working as thoroughly as possible. He should find out the good and bad points of various bullets, and, what is even more important, should definitely know their limitations. In the .30/06 rifle, for instance, any intelligent handloader would throw up his hands in horror if a friend suggested that he try to step up a 220-grain bullet load to give a muzzle velocity of 3000 f.s. He would know immediately that, with existing powders, such velocities would be possible only with bullets weighing a maximum of 150 to 160 grains. And yet he will take his .38 Special or .44 Special and endeavor to drive the standard weight bullet to truly super velocities merely through increasing the powder charge. It can't be done.

Handgun Loads. There are four distinctive types of handgun loads: (1) The Gallery, designed strictly for indoor shooting and of no particular value in the open air; (2) the Target Load, suitable for target shooting at all handgun ranges outdoors—20 to 50 yards; (3) normal handgun loads with standard or near-standard bullets; (4) assorted loads for hunting or killing purposes. These may include low, standard or high velocities.

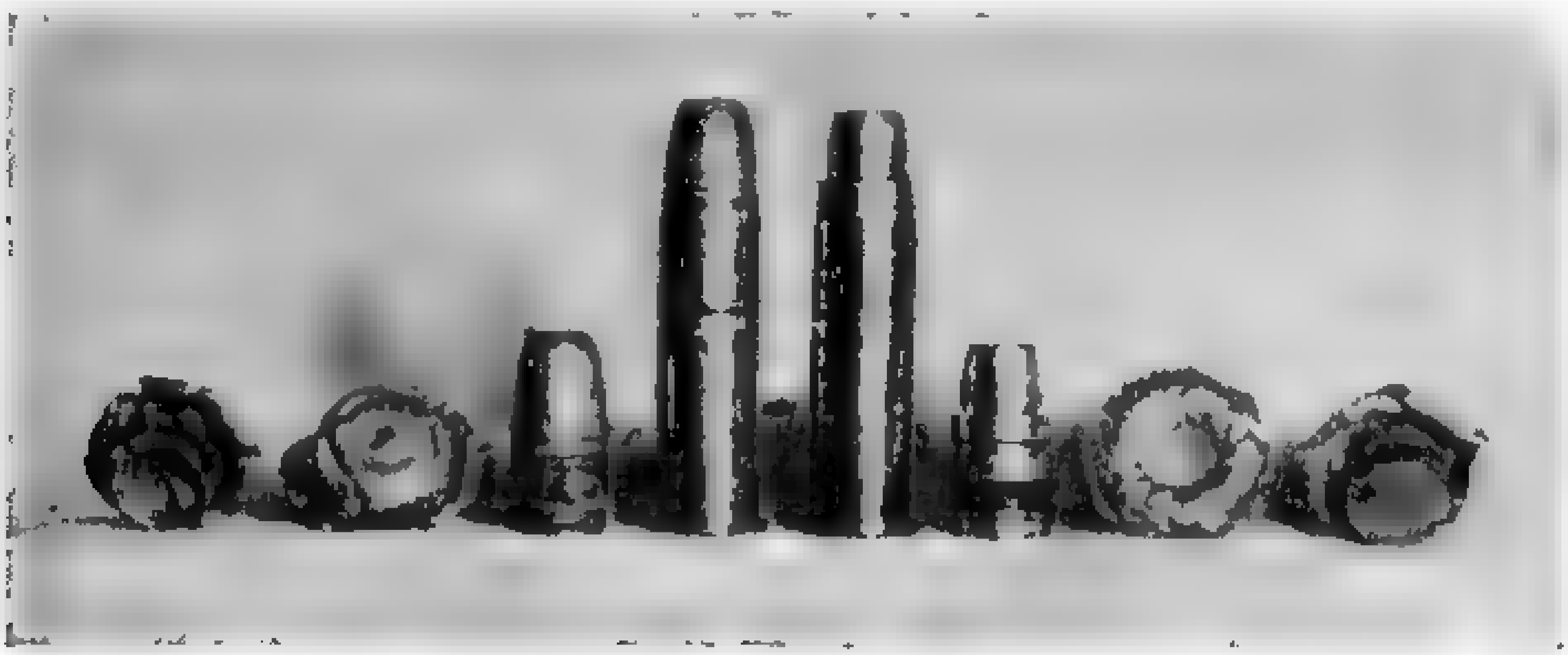
The problem with Gallery loads is sight adjustment. To the man who has several guns in a given caliber, this offers an excellent means of indoor practice. I know of one chap who has two identical standard-weight .38 Special revolvers. Both have six-inch barrels and are equipped with target sights. One of these has a special high rear sight to accommodate indoor Gallery loads. He shoots countless rounds of handloads, using round cast bullets or 000 buck. This particular gun is used for no other shooting. With the sight equipment on it, it would shoot several inches high at 20 yards, but for the range of 40 feet which happens to be the maximum available in this experimenter's cellar, his squib loads group center. His matching gun is used for normal outdoor shooting with assorted ammunition.

Revolvers and Automatic Pistols. There are two distinct types of handguns which should be carefully studied before any loading is attempted. They include revolvers and automatic pistols. The former is by far the most popular among handloaders. It invariably means an extremely wide assortment of bullets available, and permits of almost any desired combination and velocity. Reloading for automatic pistols, on the other hand, greatly narrows the field. Most pistol men do not wish to single load, and this necessarily means the use of the metal-jacketed bullets identical with the factory load or an alloy bullet of approximately the same contour. It also means that the standard factory velocity must be used as a working level, particularly if magazine functioning is desired. Should the load be too light, the empty case will not be ejected and thus the gun must be two-hand operated for each shot. If the load is too heavy, serious complications may arise. Furthermore, the automatic pistol—self-loader it should be called—is designed to eject the empty brass cases. In shooting out-of-doors the prospective handloader may find it necessary to chase all over the community trying to locate his brass amid sand, gravel or grass.

If the handloader shoots in the presence of a companion and is using the automatic pistol, his companion is kept busy spotting and trying to remember where the empty cases are ejected. If the handloader shoots alone, he develops the annoying habit of keeping one eye on the flying brass so it will not be lost, and this is by no means con-

ducive to good shooting. Accordingly, while handloading for automatic pistols is practical, it has never found extreme favor among shooters. The several mechanical reasons mentioned explain why many of our ammunition manufacturers are rather reticent about selling components for automatic pistol ammunition.

The revolver is extremely interesting to the handloader. He can understand a few of the weak points of his gun and govern himself accordingly. First of all, factory working pressures for handgun ammunition are much lower than those for automatic pistol fodder. Neither Hercules nor Du Pont will recommend loads developing pressures much in excess of 15,000 pounds. Factory working pressures for all revolvers are held down to this limit, with the exception of the .38 Special high-velocity loadings including the Winchester Super-Speed, United States Speedster, Remington .38/44, Peters High-Velocity and Western Super-X. Actual tests made in several pressure guns by or under the direction of the author indicate that these loads have pressures of 20,000 to 21,000 pounds, which explains why they are recommended for use only in heavy-frame guns.



Hollow-point bullets can be made to perform properly in the .38 Special if used in the high-velocity loadings. Above are two .38 Special handloads using hollow-point bullets

One revolver cartridge having a high pressure is the new Smith & Wesson .357 Magnum, described in more detail in Chapter XXX. Automatic pistol ammunition, on the other hand, is built with a working pressure of 28,000 to 30,000 pounds in such calibers as the .38 ACP, 9-mm. Luger, and so forth. The Luger is breeched up in a way very similar to a rifle. The .38 ACP has an extremely heavy barrel supporting the cartridge case. The additional wall thickness of this barrel in the vicinity of the chamber permits of these high working pressures.

Most handguns which blow up show first signs of danger at the breech end of the barrel. Where this barrel screws into the frame, one will note a thin projection extending to the forward face of the cylinder. This is a delicate part of a barrel, and this part is a bullet resizing die, swage, or what you may choose to call it. The rapidly traveling bullet jumps from the cylinder into this throat or cone of the barrel, which is somewhat larger than the bullet itself. The force of the action, however, expands the bullet to a size greater than the barrel diameter, and when it strikes this throat or cone, it must be swaged down to proper size and at the same time must be given the necessary rotary motion to start it through the bore. If the load is too heavy for the gun used, or the bullet is too soft, one will notice a belling of the barrel breech after extensive firings. If this starts, the barrel should be rejected, as the belling will immediately increase the space between the barrel and cylinder. The gun should be returned to the factory for the fitting of a new barrel. Continued use will mean continued belling out of that barrel and will eventually result in a totally ruined gun through splitting the frame at that point.

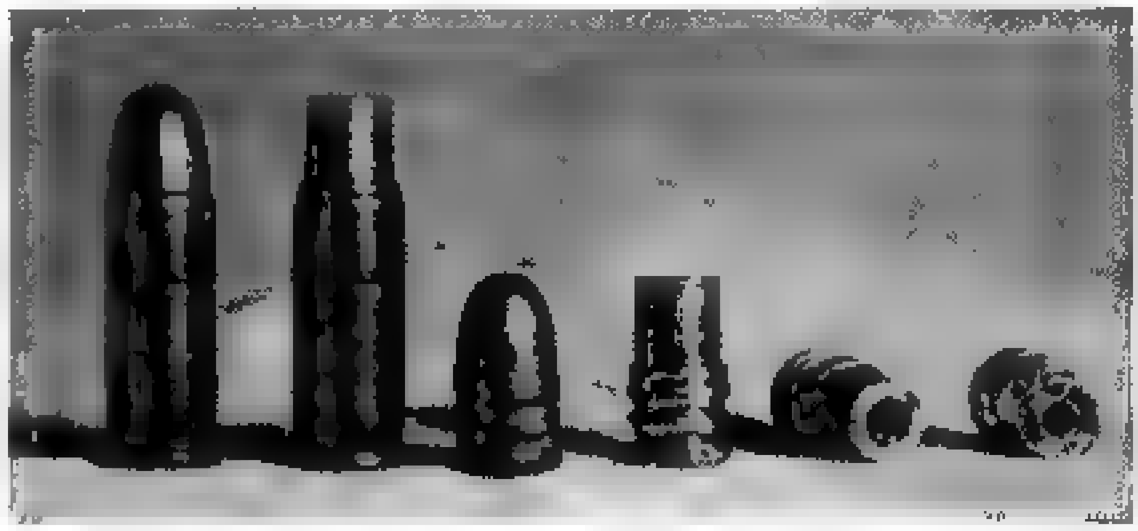
With maximum pressure loads too great for the gun to stand, several things can happen. With the modern swing-out cylinder revolver the loads can strain the mechanism so that the cylinder strikes on the rear of the barrel and causes binding. The tremendous torque of the bullet as it starts down the barrel can blast the frame out of alignment. Last but by no means least, a more or less delicate top strap running from the forward end of the frame across the top of the cylinder may become so strained by the forward drag on the bullet as it hammers into the rifling that a rupture

will occur, usually at the angle between the top strap and the standing breech in front of the hammer.

The next problem is the cylinder. Handgun makers, including both Colt and Smith & Wesson, have always made their barrels out of soft steel. Both makes are of an entirely different formula, and each, of course, claims superiority over the other. When used with ordinary lead bullets, both makes of barrels will last indefinitely, as, despite the softness of the steel, repeated tests have shown that they have a useful life with factory loads of from 30,000 to 60,000 rounds—which is a lot more than the average handgun shooter will pour through one barrel in a lifetime. Cylinders, on the other hand, are built of a special chrome nickel steel, each manufacturer again using his own formula. Of the two makes, the Smith & Wesson appears to have the edge on the Colt, but with any reasonable loads or normal overloadings either the Colt or Smith & Wesson guns will stand up.

Handgun shooters far and wide are constantly mistreating their handguns for reloading purposes. The marvelous thing about it is not that guns blow up, but that more of them *do not* blow up. Within the present week of this writing the author received a letter from a chap in Philadelphia who tried to use a 12-grain charge of Bullseye behind a standard bullet in his .44 Special Smith & Wesson Military Target. The pressures of this load must have been equal to or possibly greater than that of the Springfield rifle. He only fired two loads, tying the gun securely to a post and pulling the trigger with a string. The gun, so he reported, held perfectly, and he did not continue his test for fear of damaging the gun—not by blowing it up but by denting its nice shiny finish because he was unable to lace it down properly so that it would not tear loose from its mounting. That's good logic—not!

During the past twenty years our two American handgun manufacturers of consequence have been more or less continually improving the steel used in their guns. They have concentrated upon the real wear on the cylinder, both Colt and Smith & Wesson using the finest chrome nickel they can possibly secure. They know only too well that a gun may be strained through various parts, but that it really does not begin to blow up *until the cylinder lets go.* When this happens, the net result is frequently the splitting through of the walls between the chambers on both sides of the one being fired, thus shooting three cartridges simultaneously and generally removing about that many chambers of the gun. This, of course, usually takes off the top strap along with it. The gun is, incidentally, turned into scrap metal. While this form of accident does happen more or less frequently because of careless handloading, an overcharge, or the wrong kind of powder, the odd part of it is that the shooter is rarely injured. Nevertheless, it is unhealthy to try. The arms makers, knowing a few of the things which can happen, have not only taken high grade steels for this essential part of the mechanism, but have continually experimented with various forms of heat treatment to make these cylinders stronger still.



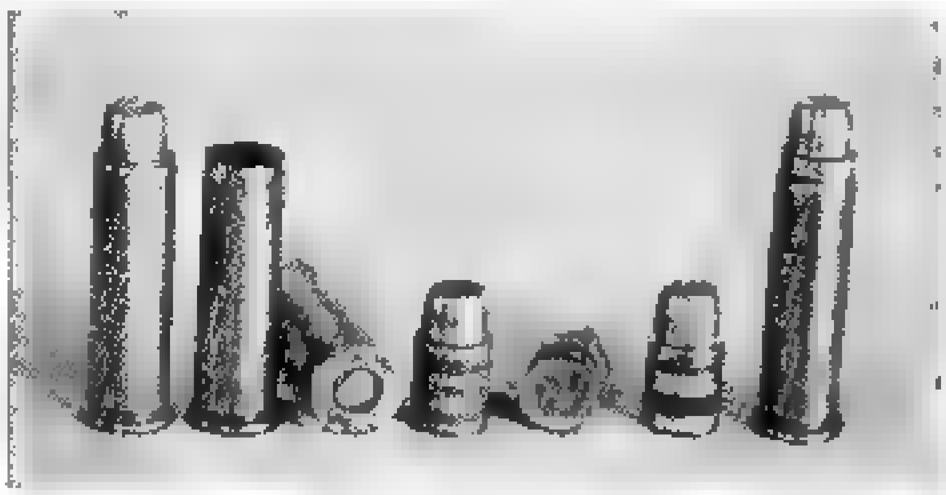
The standard .44 Special cartridge shown at the left can be converted into a far more deadly cartridge by the addition of a hollow-point bullet, as shown. This makes an excellent hunting revolver of this caliber

Handloading for Revolvers. Thus understanding the weak points of handguns, proceed carefully to analyze methods of handloading. Always use the lowest power of load which is consistent with the work at hand. A low-velocity load with a light bullet means less wear and tear on the gun, on the shooter, on the brass cartridge case, on the powder cannister, and on the shooter's pocketbook, to say nothing of his shooting arm. Of course, if you must have recoil, you must; but the average shot can usually do better with a mid-range bullet load than he can with a Super-de Luxe hell-tootin' maximum load.

As with all other forms of handloading, the handgun game begins with the brass cartridge case. This should be decapped as soon after the firing as is possible, and an effort made to clean out the primer pocket to free it of débris. Most of the new non-corrosive primers leave a very hard gritty mess in the bottom of the pocket, which flakes off very easily. It can frequently be removed with toothpicks, and a supply of these should be kept on hand to prevent complications in case of breakage. These deposits, if left in the pocket, frequently prevent proper seating of the new primers, since it is routine for the primer to flatten and *move back* in the pocket to contact the breech face of

the gun, leaving plenty of room for débris beneath it.

If you have one of these Handee Grinders you will find the cleaning process to be extremely simple. Use the end brush, and with the left hand gather up a few cases, holding them head up. Then merely run the spinning brush into the pocket of each, holding it there for a scant second.



The standard Smith & Wesson .357 Magnum revolver cartridge compared with a more effective handload in the same caliber. Note difference in bullet seating depth

As a test the author has cleaned 200 cases in this manner in approximately three minutes. The decapped cases may be put away for future use, resized or unresized according to the tools on hand and the wishes of the handloader. It is usually a better plan to resize them before putting them away as they are then in much better condition for immediate use when wanted.

Should handgun cases be full-length resized? There are two sides to this question. Some handgun fans say no. The author full-length resizes all revolver cases, thus permitting them to be used in any gun available. At the same time the full-length resizing makes them fit easier into the cylinder and holds the bullet more securely, thus making for increased performance and more uniform shooting.

The revolver loads should be crimped at the time of loading, which in turn necessitates removing the crimp from the case mouth. There are many ways to do this. One of the simplest is to use a steel ball bearing if no loading tools are available. Place it over the mouth of the fired case and tap securely but gently with a hammer. I have seen this stunt worked so skilfully that the case mouths were but slightly belled, and in 50 consecutive cases prepared by one man there seemed to be little or no variation. Instead of a hammer he used a hardwood mallet of light weight and knew exactly how to tap. He only used one blow per case

Another method is to use a large steel rod properly beveled and securely clamped in a vise. The cartridge case is slipped over this, mouth down, so that the crimp contacts the bevel, whereupon the person holding the case in his fingers presses hard while he rotates the shell. This stunt also works well but is rather tiresome on the fingers.

All the modern reloading tools have some means or other of removing crimp and slightly flaring the mouth of the shell. This flare should be slight, but at the same time should be positively there, otherwise the lead bullet will shave in being forced home during the seating operation. If you have one of the larger tools you can even combine the process of decapping, recapping and resizing, including the expanding of the mouth, all in one operation. If you intend to use these shells for further reloading within six months or so, it is perfectly proper to reprime them at that time, as they will then be ready for immediate use upon the addition of the powder and the seating of the bullet.

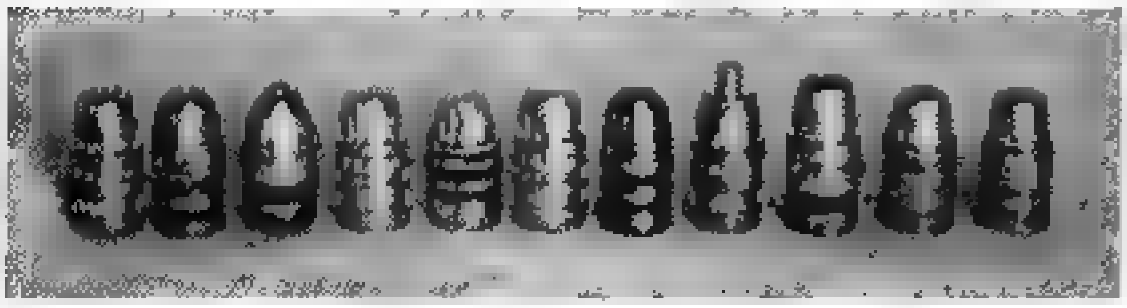
Should cases for handloading be expanded inside of the neck? This is a problem to which there is no definite answer. There are no two authorities or loading tool makers who will agree on this. The operator should therefore decide for himself or let the design and construction of his tool decide for him.

Cartridge cases for handgun calibers differ somewhat from the rifle type in that they are by no means so strongly constructed. The chap who wants a really strong case for the .38 Special will find it in the Winchester .35 Self-Loading rifle case. Certain types of handgun shells in this caliber are quite successful in recent years, owing

A few of the experimental cartridges used in the development of the Smith & Wesson .357 Magnum. The factory Magnum load is shown on the extreme left

to improvements in brass drawing and in construction. Many shells in the .38 Special will be found with both solid head and the semi-balloon type of construction. The former appears to be "flat bottomed" if you look into the cartridge case. The semi-balloon type of head has the primer pocket projecting into the case and is by no means as strong as the former. This type, which was the

original so-called "solid-head variety," was introduced in the late 1880's or early 1890's. The coming of the Krag rifle cartridge necessitated the true solid head web type of construction. (See Chapter III, "The Cartridge Case.") Remington and Peters have for several years made all their .38 Special cases of true solid-head web construction. About 1933 Winchester, Western, and the U. S.



A few bullets used in developing the Smith & Wesson .357 Magnum. The factory bullet finally adopted is shown on the right, second from the end

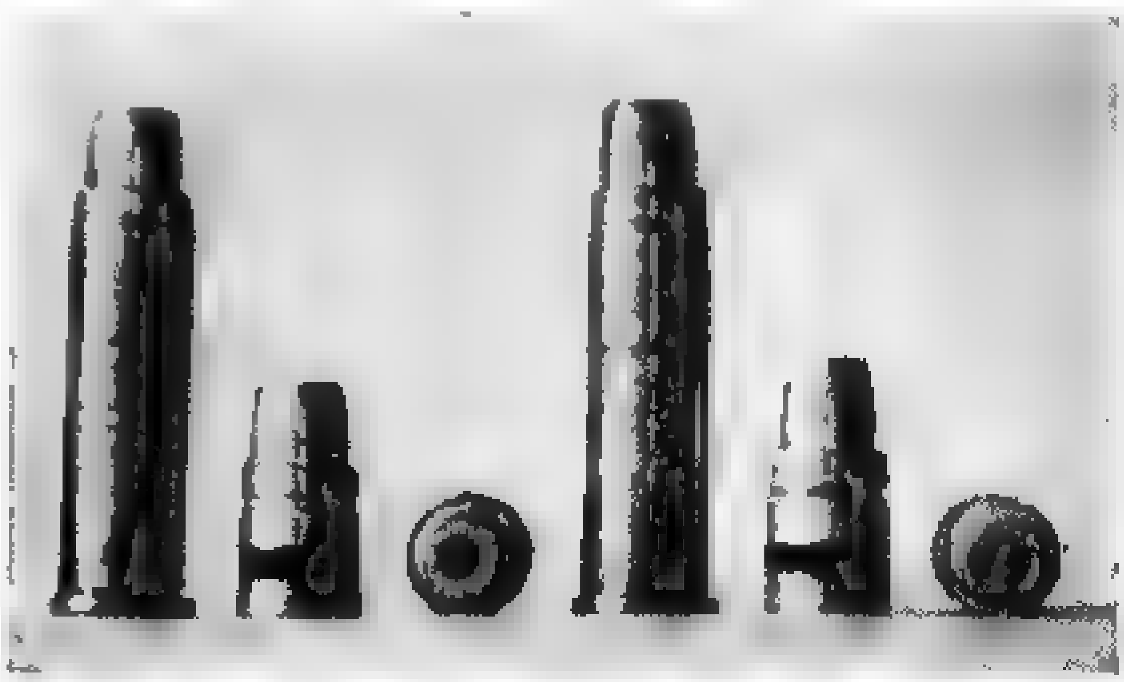
adopted the solid-head web and crowded the semi-balloon type out of the picture, particularly in this caliber, although it is possible that for many years to come the semi-balloon head will be available on some dealers' shelves when "new" ammunition is purchased.

For handgun use there are two definite sizes of primer pockets: the .175-inch and the .210-inch. The .175 is the most common. It is used by Remington, Winchester, Western, U. S., and formerly Peters. The large size is now standard for all .38 Specials and other big calibers in Peters and high-velocity Winchester and U. S. The semi-balloon head, while it has been abandoned in cartridges of the .38 Special variety, is still widely found in the big bores such as .45 Colt, .44 Special, and so forth. This case will not stand the pressures of the modern solid-head web type and should be carefully set aside to prevent its being accidentally mixed with the solid-head web variety. None of these cases should be depended upon to handle pressures in excess of 15,000 pounds.

What would happen if the cases became mixed? In 1933 Du Pont Burnside Laboratory ran tests of this sort to gather definite answers to this question for the author. Primers used were Winchester #108 non-corrosive. Two types of Winchester .38 Special cases were used—the semi-balloon head and the solid-head web. Standard Winchester factory bullets backed up by a 5-grain charge of Pistol #5 completed the load. In a series of tests, the semi-balloon type head gave a mean instrumental velocity of 891 f.s. with a pressure of 14,500 pounds. The solid-head web type gave a mean instrumental velocity of 922 f.s. with a pressure of 16,000 pounds, net difference 31 f.s. and 1500 pounds pressure. This of course with a normal standard charge. It is quite possible that, should these cases become mixed, the point of impact might be entirely different, because of the difference in velocity and pressure and its effect upon barrel time and jump of the gun.

Primers. Only non-mercuric primers should be used. For many years the Western Cartridge Company used mercuric types both in the old corrosive and its successor the non-corrosive. They have for years been loading non-mercuric types in certain calibers and any handloader desiring Western non-mercuric may get these by specifying their catalog numbers and requesting the type of primer composition.

Do not mix different makes of shells. Each manufacturer has his own ideas of wall thickness, primer-pocket shape, flash-hole diameter, and other things. No one can assemble truly accurate loads with assorted cases. They should be kept separate and each shell primed with its individual make of primer. It is possible to swap Winchester and Remington primers in their respective cases, but this is never truly satisfactory. The Remington primer pocket is designed with square bottoms, while the corresponding primer has a somewhat longer cup. This primer is supported after being pushed home on the rim of the cup. The Winchester works just the other way. The cup is somewhat short. The pocket corners are rounded



Heavy handloads for the .38 Special. Left: the Sharpe hollow-point bullet. Note small diameter of cavity. This is a straight cavity 1/10 inch in diameter. Right: the Keith bullet. This has a semi-conical cavity

and the primer is designed to be supported *on the anvil* when properly seated. Winchester primers are not as successful in Remington cases as in their own make, but they are much easier to handle than Remington primers that you are trying to seat in Winchester cases. The latter stunt frequently results in crushed primers, as the round edges of the pocket bottom are forced to crimp the mouth of the cup over the anvil.

In priming the cartridge case for both handgun and rifle use, one should know the difference between our two major makes of primers, the Remington and the Winchester. The Remington type is, for the most part, flat on its top surface. The Winchester has a concave surface. That is one particular point which loading tool makers have constantly overlooked, and they turn out primer-seating punches in proper size but rarely, if ever, in proper shape. If you will examine factory-primed shells, you will find that there is not the slightest mark on the face of the primer. Why? In the factories the machines ram home primers perhaps a bit more rapidly, but essentially by the same process as that used by handloaders. The answer is that the face of the seating punch fits the face of the primer.

What difference will it make if a primer is slightly crushed or otherwise mutilated? This question can be answered very definitely, since it has been tested in laboratories. A mutilated primer cup means that the priming composition cake within the cap has been broken up. This is designed to be, at all times, solidly fixed within the cup. It is inserted while wet, pressed into position, and permitted to dry there. If this cake is broken, the result is likely to be a hangfire and generally faulty ignition. Elsewhere in this book is reproduced a micro-photograph of the effect on the priming pellet of a cap slightly mutilated by the seating punch. It tells its own story.

Powders. A number of good powders are available for handgun loads. Among these are Du Pont Pistol #5, Pistol #6, Sporting Rifle #80, and the Hercules Powders, Unique, Bullseye and #2400. The last-named powder is excellent for heavy loads. Its use in this field was not discovered until late 1934, when one of our large factories was seeking a suitable powder for the loading of truly high-velocity handgun ammunition.

The average handloader prefers to measure his powder charges rather than weigh them out individually. He thinks nothing at all of shooting 100 rounds of handgun ammunition on a single afternoon's shoot where he ordinarily shoots a rifle less than half that number of times and accordingly "can afford to take more time with his loads." Any of the gravity powder measures will work with all powders listed, but it should be clearly pointed out that the truly heavy loads in any caliber should be treated with the same reverence accorded high-pressure rifle loads and should always be weighed. If you have any doubt about the probable performance of any particular handgun combination of cartridge case, priming, or bullet, write directly to the laboratory of the powder manufacturer, listing the load that you want to use, the type, weight and diameter of your barrel, and the gun you wish to use it in. The laboratories will gladly assist you if you will state what powders you have available.

In seeking special information of this sort, you should note all the above facts and submit them along with your inquiry. The laboratory can better help you if they know all these facts, particularly what powders and bullets you have available. If, for instance, you have a Belding & Mull mould for a 145-grain bullet and a quantity of Pistol Powder #5, it will not help you a great deal if the laboratory sends you information on a load with a Bond 158-grain bullet and Pistol Powder #6. Don't expect the laboratory experts to be mind readers. State your case and you will get proper assistance.

Seating the Bullets. After your powder charges have been decided upon, weighed or measured and entered into the primed case, you are ready to seat the bullets. This operation, of course, depends to no small extent on the type of tool available. Information on this is submitted with the tool by the manufacturers. Every handloader should be sure to get all available factory literature covering his individual make of tool.

There is one point in the handloading of ammunition which to a great extent controls the uniformity and accuracy of shooting—the crimp on the bullet. A ballistic engineer connected with one of our large ammunition factories once told the author that most home loads in handgun calibers were inferior to factory loads, and that this was due chiefly to the crimp. Even the best-made loading tools on the market will vary, and some of them have an annoying habit of running off side crimps very consistently. This permits of a crimp which is much deeper on one side of the shell than on the other, and results in improper delivery of the bullet. It is usually caused by an oversized loading chamber which permits the natural thrust of the tool to cause the cartridge case to be tilted to one side during the bullet-seating and crimping process. Few if any of our so-called straight-line bullet seaters actually seat in a straight line, not because of their design but because of these manufacturing tolerances. You can seat a bullet in a straight line, but unless the case is held rigid during the process there is bound to be a certain amount of tipping.

Handgun ammunition for hunting may include any of the various forms of wad-cutter or hollow-

point types. Among these are the very excellent Keith-Ideal form and the Sharpe bullets in .38 Special, .357 MAGNUM and .44 Special, moulds for which are made by George A. Hensley of San Diego. These combination wad-cutter and square-nose forms of bullets, together with many others of similar outline now put on the market by Bond, Belding & Mull, and Ideal, both in solid and hollow-point construction, offer the utmost in shocking power. In loading them there is just one particular caution—one should use a bullet-seating punch which properly fits the ends of the bullet. The methods of seating, loading, preparing the shells and crimping are exactly the same. The handgun fan who does his own loading will greatly increase his shooting possibilities, whether he casts his own bullets or purchases them all prepared.

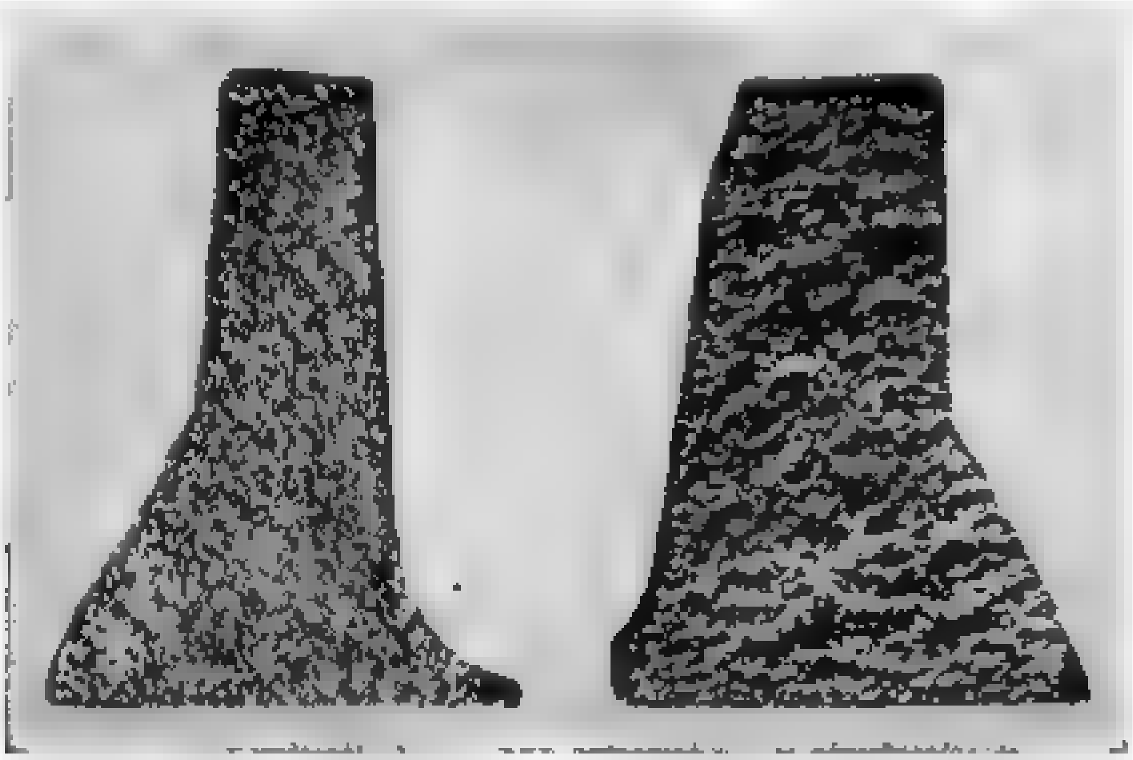
The gentle art of handloading for handguns also makes an arm more of an all-round weapon than would be possible with factory ammunition.

It is a great sport!

XXX

MAGNUM HANDGUN AND RIFLE POSSIBILITIES

THIS is the day of Magnum ammunition. Although there are thousands of handloaders who stick by the old-style equipment and arms and prefer to load only light or normal charges, there are likewise a goodly number who seek the most powerful loads it is possible to assemble. Magnum loads include the group of cartridges known as "high-velocity" or "high-power." Perhaps the



Reasons why extremely high pressures must not be used in the old-style Springfield rifle with the case-hardened receiver. The above receiver sections are from rifle #658179, and the receiver was broken by sharp taps with a hammer. Note crystalline structure of the metal

best definition of the term is that given by A. C. Hale, managing director of the world-famous Parker-Hale Organization of England, who defines Magnum ammunition as ammunition having "a greater chamber capacity than military dimensions, and power beyond the normal expectancy of the caliber." A Magnum load, therefore, is anything which is "stepped up" in power and should be so treated by the handloader in analyzing the possibilities of his equipment.

The first thing to look for in developing any Magnum load is the quality of the gun which is to use it. The famous .38/40, for instance, of Winchester or Marlin make, is not merely a definite type of gun. The Model 1892 Winchester, for example, has been manufactured continuously since that year. If the handloader should happen to have one of these first Winchester Models, he must bear in mind that the action was designed for black powder and black powder only. If he loads smokeless powders, he should load to the black-powder pressure level and attempt to use certain of the old bulk powders in preference to the later dense powders.

There has been a great deal of improvement in steels, whether they be ordinary soft steels or various forms of nickel steel. No attempt will be made here to describe steels, as the subject would require an entire book. Thirty years ago, very little was known about heat treatment. Today it is one of our most definite sciences, and steel can be made from two to five times its usual strength merely through scientific heat treatment. If you had a Winchester Model 1892 manufactured in 1905 and an identical model manufactured in 1935, assuming the original gun to be in perfect condition inside and out, you might place them side by side and notice absolutely no difference at first glance. Careful study, however, will reveal that the later gun is manufactured better, with a minimum of tolerance, slap, looseness or whatever you may choose to call it. That, however, is the *minor* part of the whole thing. There will be little laboratory resemblance between the *materials* of which the two guns are manufactured. Changes and improvements are being made constantly, and where changes in the quality of steel or the strengthening of certain parts through heat treatment are made, the factory rarely, if ever, makes any announcement. If these same Model 92 rifles were fired with a Magnum .38/40 load, it is quite possible that the earlier gun might go to pieces, while the later one would be perfectly safe. These facts must always be considered in handloading.

A few things about the gun and its possible strength can be determined by the handloader through visual inspection. He should test the headspace, check up on the size of the firing-pin hole and the type of blow the pin delivers to the primer. He should check his chamber to determine whether it is oversize and give the bore the same consideration. He should check the locking lugs of his breech mechanism to see if they fit properly and are not excessively worn. The steels of which they are made, however, cannot be checked at home. It is recommended that each individual, should there be the slightest doubt in

his mind, write direct to the factory listing the serial number and model, and ask for the approximate date of manufacture and the probable pressures that gun will stand, assuming it to be in good condition. The factories will be glad to cooperate with you.

All firearms, whether they be ancient, more modern or strictly up to the minute, have certain very definite limitations of strength. To attempt to crowd them, invites disaster. Lever-action guns will not stand the breech pressures of the bolt-action type. There has always been a great deal of controversy regarding the strength of these guns. To state definitely that a gun will stand a certain pressure is dangerous. It may stand much more and it may not. Accordingly we will let the gun manufacturers speak for themselves.

Merton A. Robinson, Ballistic Engineer of Winchester, once called in question a statement of mine in a sporting magazine to the effect that the Model 94 and similar Winchester lever actions were unsafe with pressures in excess of 40,000 pounds per square inch. Mr. Robinson wrote:

"Your comment that lever-action rifles will not continually handle breech pressures in excess of 40,000 pounds is presumably based on the matter of free functioning rather than safety. We have found it necessary to confine pressures of cartridges adapted to lever-action rifles such as Model 94 to 40,000 pounds or thereabouts on the basis of extraction troubles. Unless the shells are processed exactly right, sticking may be encountered where the pressures are increased materially, but we would not hesitate to fire these models OF CURRENT MANUFACTURE with considerable increase in pressure, bearing in mind safety or durability alone. . . .

"The Model 95, on the other hand, will handle factory-loaded .30 Government Model 1906 cartridges where the breech pressures are up in the neighborhood of 50,000 pounds with perfect safety. Our control tests and comparison of firings of various brands and types are made in the Model 95 as well as bolt-action models of this caliber, and we have yet to find a failure due to weakness. We have consistently recommended against the use of cartridges giving extreme pressures in the Model 95 due to the possibility of extraction troubles where the leverage factor is much less than that in the bolt-action type."

A few of the experimental cartridges designed by Wotkyns and Sweany in their work prior to the development of the .220 Swift. Some of these cartridges were successful; others were total failures

Commenting further on burst .30/06 Model 95's, Mr. Robinson writes:

"Several years ago, a number of Model 95 rifles, caliber .30/06, were burst. Careful and detailed investigation developed that in several instances the damage was caused by the firing of an 8-mm. cartridge through the barrel chambered for .30/06. We duplicated the results in our own gallery. As a starter, we fired an 8-mm. 236-grain soft-point bullet cartridge in a .30/06 pressure barrel, and while it was seated with difficulty, it fired perfectly and registered pressures of about 90,000 pounds per square inch. A second trial with a full-patch bullet weighing 227 grains gave us an estimated pressure of 120,000 pounds, since this load was beyond the capacities of our crusher cylinders to properly register. We fired a full-patch bullet cartridge through a Model 95, employing the usual protection of firing with a lanyard offering protection to the operator. The rifle, after the explosion, was naturally a mess. The receivers spread apart, fractured, and in fact duplicated the condition of the guns returned.

"Before we had definitely determined the damage was due to the use of an 8-mm. cartridge, the management authorized the discontinuance of the

Model 95 in this caliber. This decision was also presumably hastened by the fact that many returning soldiers, who previously favored the lever action, had familiarized themselves with the bolt action and were looking for the same type of gun for sporting purposes. . . .

Testing the author's .357 Magnum handloads (reproduced in this chapter) at the Smith & Wesson factory. Colonel Douglas B. Wesson, operating the machine rest, assisted by M. H. Bingham

"In the case of the Model 86, we believe that when the breech pressures are increased much above 30,000 to 34,000 pounds, sticking will be encountered. In the Model 92 the cartridges loaded by the various manufacturers develop pressures in the neighborhood of 30,000 pounds per square inch. This is not the limit to which these guns may be fired, by any manner of means, but we could not guarantee freedom from sticking where pressures are materially increased. . . . You, of course, appreciate that all Winchester firearms are proof-shot, firing cartridges loaded to breech pressures at least 30% and not more than 45% greater than the service. This practice follows along that of the English proof houses."

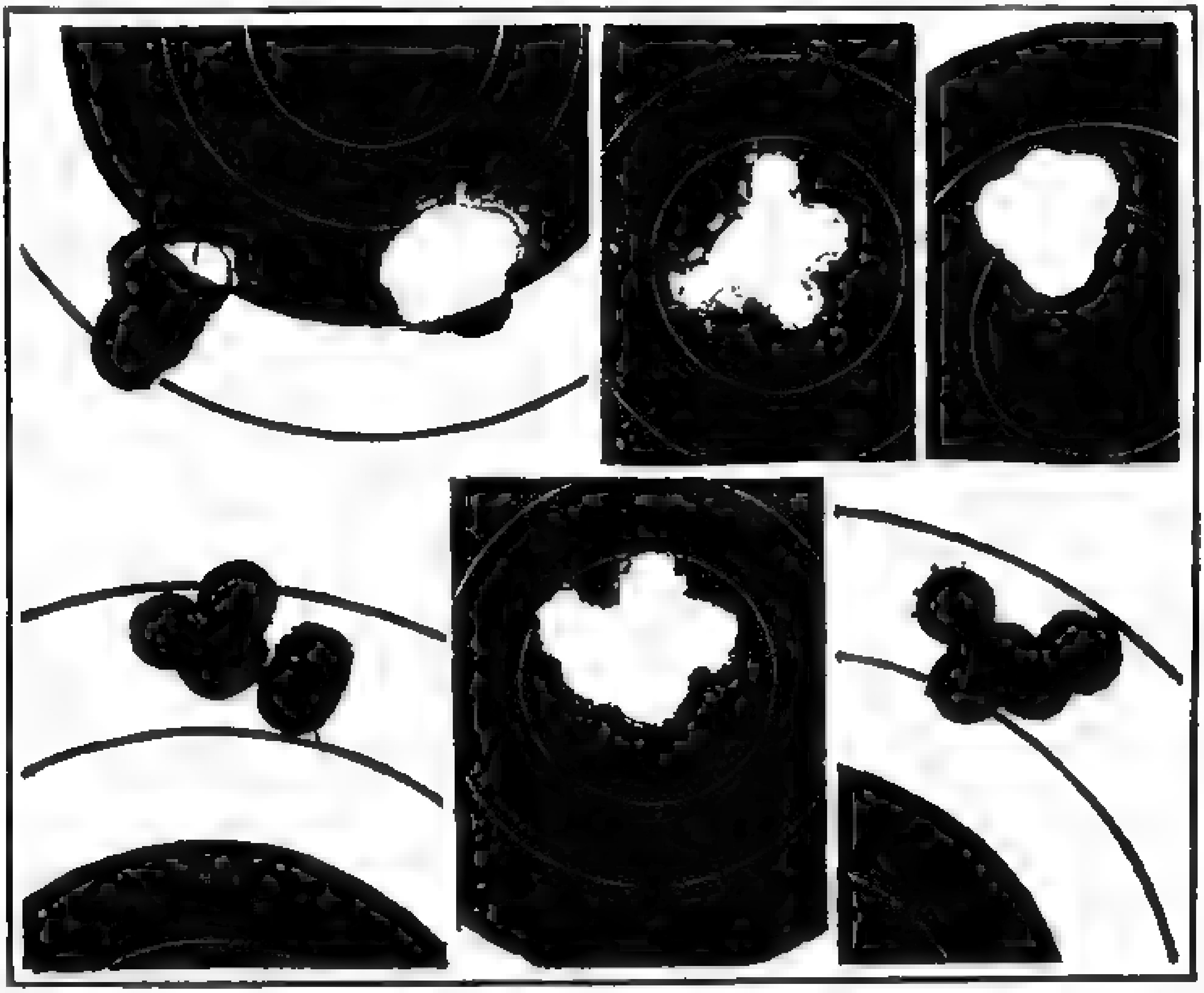
Savage guns also are built to stand heavier pressures than normal. However, in 1933 a friend of the author acquired a Model 1899 .30/30 with a poor barrel and wrote Savage for a quotation on the fitting of a .250/3000 barrel to his action. The factory wrote him: "We do not care to subject some of our .30/30 receivers of early production to the increased breech pressure of .250/3000 cartridges, and for this reason we have constantly declined to convert rifles in this manner. . . ." This is more a matter of policy than anything else. The present Model 1899 Savage rifles are being used with cartridges developing breech pressures of from 45,000 to 48,000 pounds per square inch. All barrels are proof-tested with a pressure load in excess of 55,000 pounds. In 1908, however, there was a change in the design of this model which is not generally known. At serial number about 90,000 the original square-shoulder locking lug at the rear end of the breech bolt was changed to the present oval design, which gave a much better distribution of the pressure.

All factories, owing to lack of control over handloading, very definitely withdraw all guaranties on their guns when handloaded ammunition is used. This should be borne in mind.

When lever-action guns are used with cartridges developing too great a breech pressure, they are inclined to stretch, owing to the natural spring of

the action. A stretched cartridge case may well rupture at the head. If a cartridge case lets go, there is very little to prevent its producing a wrecked gun. This should definitely be borne in mind in compounding Magnum loads, and nothing but recently manufactured cartridge cases should be used. The firing pin should be carefully examined, as well as the firing-pin hole in the breech bolt. If the hole is too large, or the firing pin too long or too sharp, the pin can readily pierce the primer at high pressures. When the primer is pierced there is nothing to hold the gas within the cartridge case while the bullet is traveling through the barrel. If the firing-pin hole is too large, the primer will flow backward into this cavity around the pin, and should pressure be sufficiently great, the primer may blow itself apart in the vicinity of the unsupported section, releasing gas into the action or into the shooter's face. These things may not cause a wrecked gun but they may seriously impair the shooter's eyesight. The eyes are far too delicate to experiment with.

It has long been accepted as a fact that the bolt-action gun is thoroughly strong, reliable and safe. This is not true. The majority of bolt action arms, particularly in the Springfield and Mauser-type family, which includes our own .30/06, are probably the strongest actions in the guns of today, but they are by no means infallible. Many thousands of old Mauser actions have been rebarreled and are widely used by shooters. Their weak points should be carefully studied and handloading governed accordingly. Steels used in bolt action guns have been improved as much as those used in lever actions.

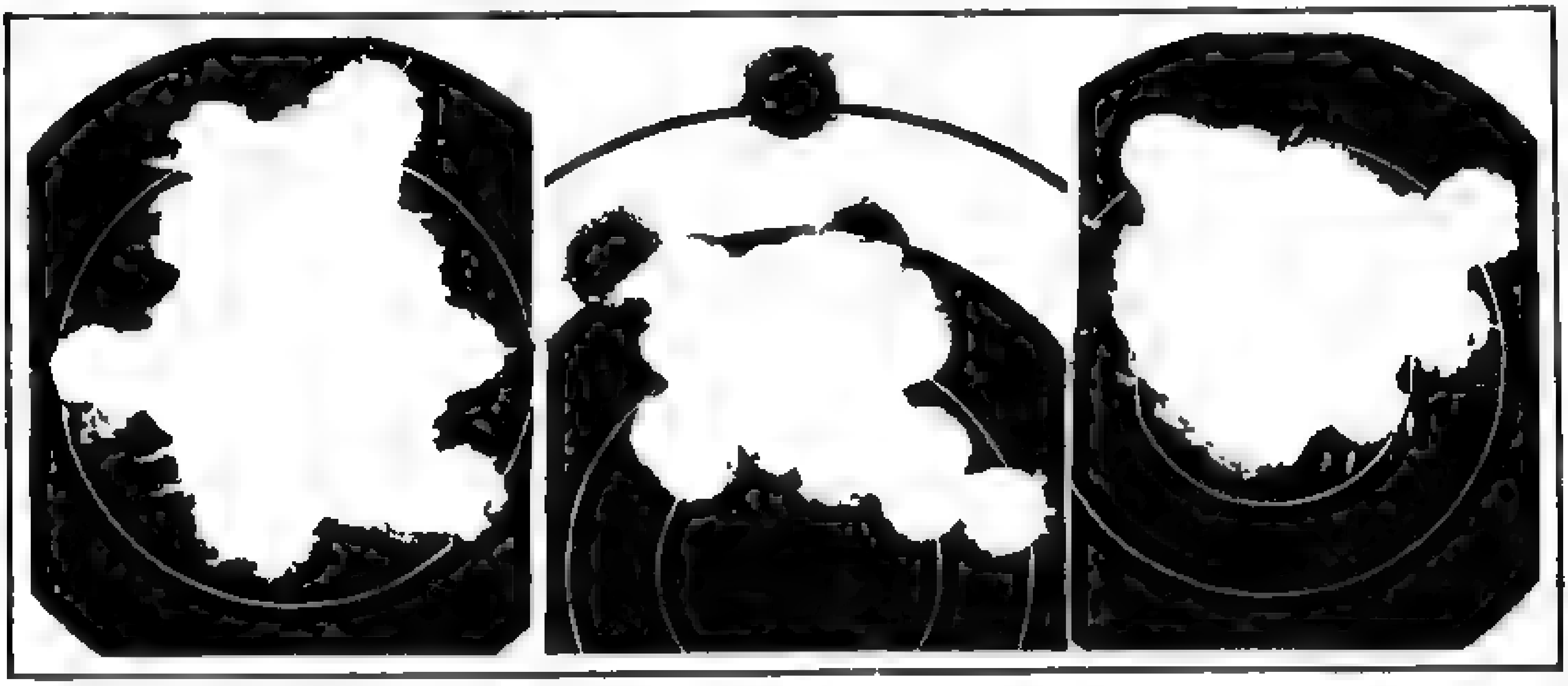


Representative machine-rest targets shot with two different .357 Magnum revolvers at 20 yards. Top row, left to right: Peters .38 Special Mid-Range Wadcutter; same, different gun; .38/44 Smith & Wesson Special; Winchester .38 Special Mid-Range Wadcutter. Lower row: Three 20-yard groups using the Winchester .357 Magnum machine-loaded cartridges. Every shot fired in the above 6-shot group will cut well into the head of a .38 Special cartridge case. Above groups are a complete cylinderful, not 6 shots from a single chamber as often fired to reduce group size in revolver testing

A particular pet of the American handloader is the Springfield Army rifle. This gun is by no means infallible, although it happens to be one of the author's pets. There have been many improvements made in it, and there is still plenty of

room for more. The steels have been changed a number of times, heat treatment has been improved, and finally the carbon-steel receivers have been abandoned in favor of the more modern nickel steels. Up to 1918, receivers were built of a steel under War Department formula #1325, consisting of carbon .2 to .3%; manganese from 1 to 1.3%; phosphorus maximum .05%; sulphur maximum .05%, and silicon .15%. In other words, it was a low-carbon steel, easily machined, soft but hardening process had been abandoned and a modern heat-treating process employed in its place. Early in 1927 nickel-steel was employed, replacing the old low-carbon steel. This change began with serial #1,275,767.

The Springfield Armory for years has been instructed to destroy all the old case-hardened receivers as rapidly as they come in for rebarreling for Service use. I know of one particular test made by a friend on a case-hardened receiver. The



Three 100 shot targets. Machine rest twenty yards with handloaded .357 Magnum revolver ammunition. Loaded by the author. Fired at Smith & Wesson factory. Note: This ammunition was loaded for leading tests by the author and consists of measured powder charges—not precision-weighed charges. Left and center targets shot with standard Winchester bullets, standard factory velocity. Left target with grease wads, center target with colloidal graphite lubrication applied to bullet groove. Right target with 146-grain Sharpe Hollow-Point bullet. Colloidal Graphite Lubricant plus grease wad. Muzzle velocity 1600 f.s. Each group was fired in a different barrel

not brittle. With a normal service cartridge developing a breech pressure of about 48,000 pounds, the two small bolt lugs take an actual blow of about 6500 pounds. That upset the soft steel of the receivers, so the old process of case hardening was resorted to to get a good wearing surface. These rifles stood up well. In fact, they were the only ones used throughout the entire war. More than 800,000 were made at Springfield, and approximately 2000 additional made at Rock Island Arsenal were so constructed.

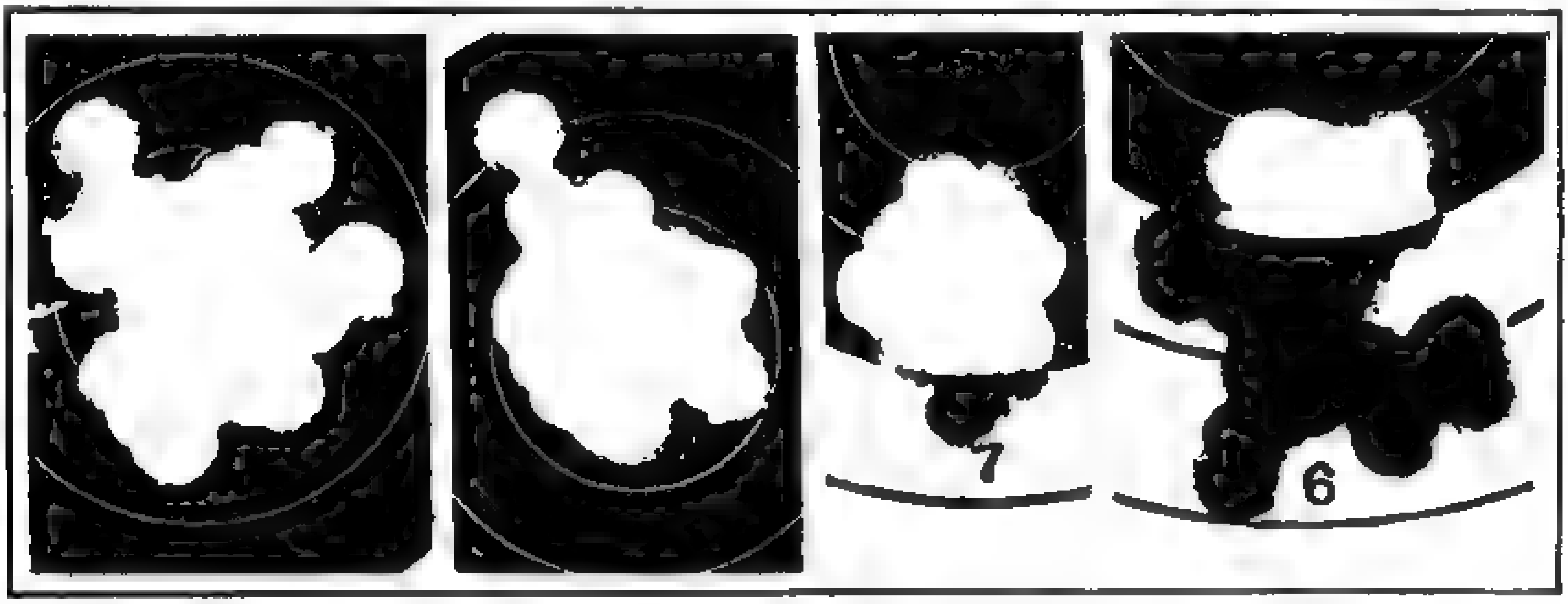
The only trouble with the case-hardening of the receiver is the resulting inability to maintain uniform depth. Because of this, a great many of the early receivers were quite brittle, without the necessary soft core to give strength. If you have a Springfield with a serial number below 800,000, it should be safe with normal loads, provided all the parts are in perfect condition. It is unwise, however, to step a gun of this type to Magnum loads. If the serial number is over 800,000, the barrel of the gun was clamped in a vise and the receiver tapped a sharp blow with a steel hammer, causing the fracture of one wall. Continuous tapping completely broke up the receiver. The stunt was deliberately conducted to test the strength of the metals. This particular gun was an especially selected one bearing the original serial #658,179, manufactured in 1917. An actual photograph of this receiver and of the fractured steel at the right side is shown herewith and clearly indicates the brittle grain of the metal. Guns of this type should never be used for Magnum loadings.

Just how much pressure will a Springfield action stand? We hesitate to answer this question, because a great deal depends on the cartridge case. If the case is made especially to withstand a pressure of 100,000 pounds, the gun would probably be safe with this load. Experimental operations at Springfield, which included nickel-steel receivers of the latest type, show proof tests at 120,000 pounds per square inch. No handloader, however, should

attempt to load any of these bolt-gun cartridges at pressures in excess of 60,000 pounds.

Despite the excellence of the Springfield and Mauser types of action, they have one extremely serious fault. If you remove the bolt of your gun and drop a loaded cartridge into the chamber, holding the receiver up to the light so that you can look down to the breech of the barrel, you may be astonished to learn that the entire head of the cartridge case projects appreciably from the barrel. This is the major weak point of the action. field, owing to the design of the action and locking lugs. Were a Springfield gun refitted with a barrel chambered for the Krag cartridge, and designed so as to fit up to the face of the bolt, it would stand much greater pressure than normal.

J. B. Sweany, California experimenter, gun bug and toolmaker, has for some years been playing with Magnum .22's, and during the latter part of his experimental work was joined by the late Grosvenor Wotkyns, co-designer of the Hornet cartridge. Experimental development of a new



Four good forty-two-shot groups (seven full cylinders) with .357 Magnum handloads, machine rest, during leading tests; range, twenty yards. Left to right: Lot B-5-E, Winchester bullet, Winchester lubricant, Donaldson grease wad, standard velocity; Lot B-7-G, Sharpe 146-grain Hollow-Point bullet, lubricated with Sharpe Colloidal formula #2. No grease wad. MV 1575 f.s.; Lot B-6-F, 146-grain Sharpe Hollow-Point bullet. Ideal lubricant. Donaldson grease wad. Velocity 1322 f.s.; Lot B-4-D, 158-grain Magnum bullet bearing Sharpe Colloidal Lubricant #2. Instrumental velocity at 50 feet 1441 f.s.

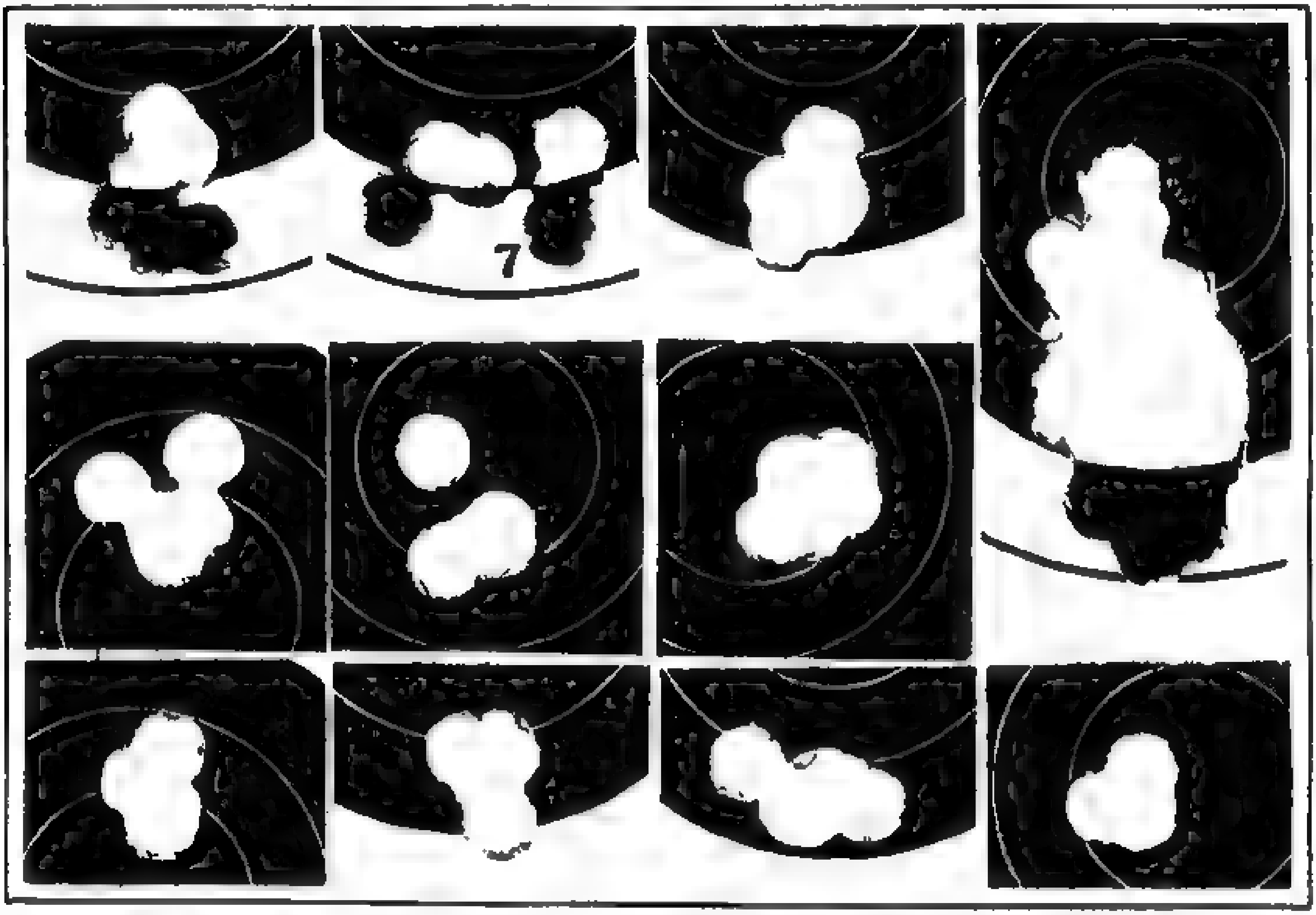
If a cartridge having a soft case is fired in that action, the brass of the case, due to excessive pressure, will start to flow backward at the unprotected portion of the head, thus causing the head to tear loose from the cartridge walls and releasing a tremendous volume of gas into the mechanism. This invariably results in a blown-up gun, although when the pieces are recovered it will be noticed that usually the receiver is in reasonable condition and that the bolt remains closed and locked.

The chap who is having a special rifle made to his order in the single-shot variety should never have it chambered for a rimless cartridge case, since the rimless case has no advantages over the rimmed in single shot. In bolt-action rifles of the Krag type, where the rimmed cartridge case is used, the entire cartridge drops into the barrel, so that its rim comes in contact with the forward face. There is less likelihood, therefore, of a rimmed case in a properly chambered barrel letting go at high pressure. The Krag is not as strong as the Spring- cartridge is always excessively dangerous. Certain conditions of bullet, powder, case shape, and so forth, will produce tremendously high pressures. In developing the Sweany and Wotkyns .220 Magnum, Sweany wrecked at least one Springfield to the author's knowledge, an accident due entirely to the unsupported head in the Springfield system of breeching. He was playing with 65,000- to 70,000-pound pressures. Accordingly he went to work on a new type of system of his own design, upon which he has made application for Letters Patent. Known as the W. & S. breeching system, this is designed for the rimmed or rimless cartridge case. In it a recessed barrel cavity or counterbore holds not only the entire case head but the rim as well. A very small extractor cut is used, and experimental firings at a pressure of 90,000 pounds indicate that cases that would let go in other types of breeching systems have consistently held in this new W. & S. type. Sweany rebuilt a new Springfield action for the author, chambered for his new high-velocity cartridge, and

even at extremely high and impractical pressures we have found extraction to be reasonably easy.

In Chapter XXIX the Magnumizing of handgun ammunition is discussed, but it is worthy of further comment here.

mind of the author several years ago. On a hunting trip with Colonel D. B. Wesson, Vice-President of Smith & Wesson, a pair of heavy frame Outdoorsmen model revolvers were used with a large assortment of handloads developed and previously



Some twenty-yard six-shot machine-rest targets fired with handloaded ammunition in the .357 Magnum revolver. All high-velocity loadings with measured powder charges rather than precision-weighed forms. Top row, left to right: Winchester 158-grain Magnum bullet with Sharpe Colloidal Lubricant #2 standard velocity; same combination; Sharpe 146-grain Hollow-Point with Colloidal Lubricant. Velocity 1475. Middle row: Sharpe 146-grain Hollow-Point bullet, standard Ideal Lubricant, Velocity 1475 f.s., all three targets. Lower row: left, same load as middle row; center, two groups with Sharpe Hollow-Point, Ideal Lubricant backed by Donaldson grease wad. Velocity, 1570 f.s. Extreme right, six-shot target fired with Peters Mid-Range Wadcutter .38 Special load in same Magnum barrel with groups fired in lower row. All groups six-shot. Upper right, 100-shot group, Sharpe Hollow-Point 146-grain bullet, Ideal Lubricant, Donaldson grease wad. Gun bedded into machine rest as firing continued, and shots progressed lower. Otherwise groups would have been approximately one-half the above measurements, vertical. All targets shot at twenty yards, proving that accuracy can be obtained in high-velocity revolver loads

The only true Magnum handgun on the market at this writing is the Smith & Wesson .357. This is an unusually potent combination and is described here in detail chiefly because a letter has just been received from a friend who, against the recommendation of the author, had an ordinary-weight revolver rechambered to handle this cartridge. It took just one shot to take his excellent gun to pieces, and he admitted his mistake—too late. He was not injured, but the gun was ruined beyond repair.

The .357 Magnum *cartridge* was born in the tested by the author. In the field they proved entirely practical, but Colonel Wesson was not content to attempt the development of a Magnum .38 special cartridge for *ordinary revolvers,* and set to work on a new gun planned in the field.

It might as well be mentioned that the Smith & Wesson .357 cartridge is loaded by Winchester at this writing at a working pressure of 35,000 to 38,000 pounds per square inch, the greatest pressure of any handgun cartridge and approximately twice as heavy as any other revolver cartridge. For more than a year before the release of this

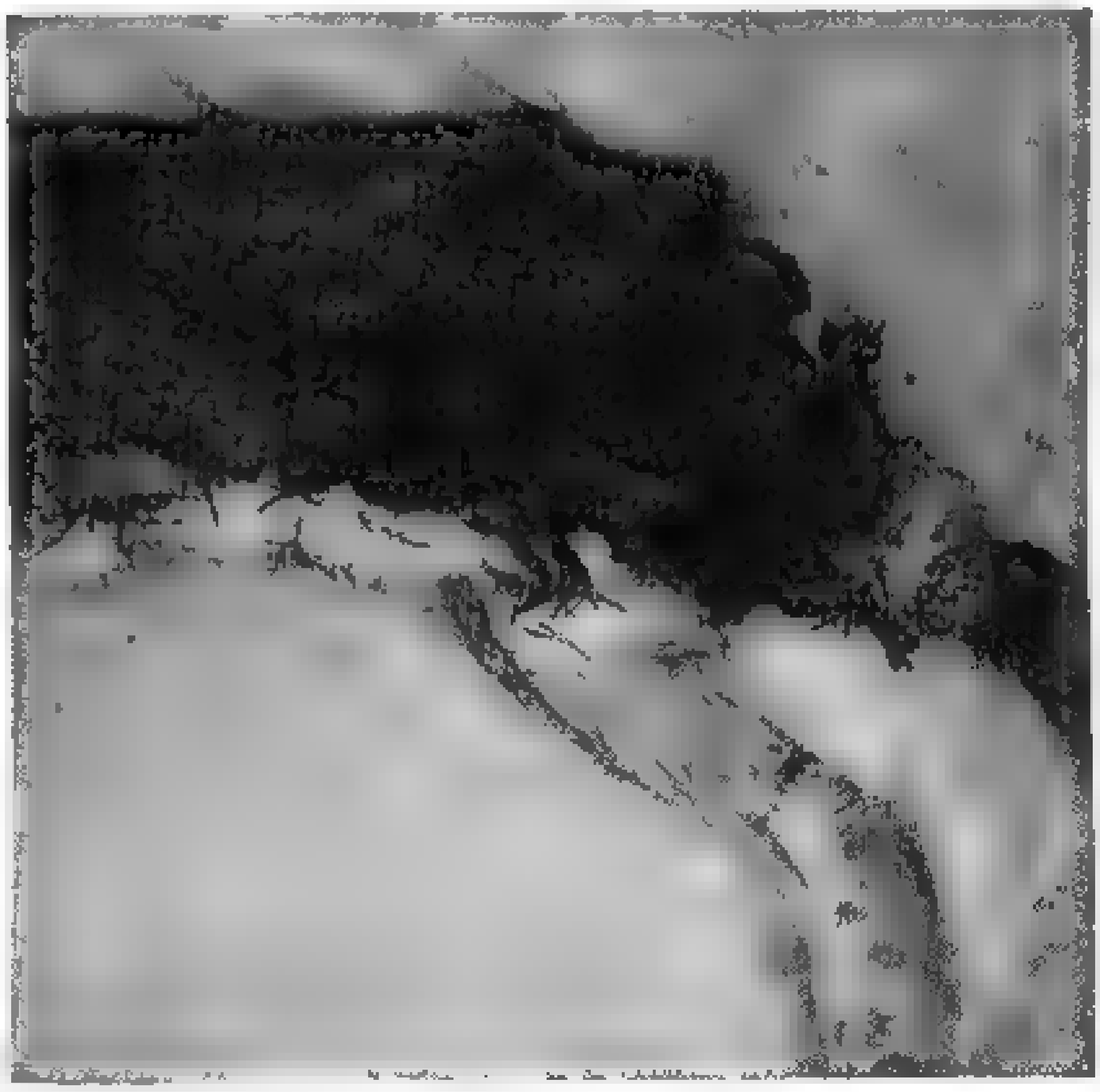
gun, Colonel Wesson manufactured a few pilot models, building and rebuilding each one, redesigning this and that until he found a suitable combination. The author is not connected with

This thirty-one-pound specimen of Bay Lynx or bobcat was shot with a S. & W. .357 Magnum bullet about three minutes before this picture was taken. Damage was all internal. Note faint traces of nosebleed, the only external bleeding

any arms or ammunition maker and desires this fact clearly understood. He did not design the gun or the cartridge, although he cooperated and collaborated in a minor way.

A number of his ideas incorporated in the design of this gun were brought out and tested through an understanding of handloading problems, and a number of weak points in ordinary revolvers were quickly corrected. More than a year elapsed before the design of this Magnum gun was completed by Smith & Wesson. During this time Winchester, Remington, Du Pont Burnside Laboratory and the Hercules Experiment Station had cooperated with the author in testing more than 100 different Magnum handloads with assorted bullets, including the 146-grain Sharpe Hollow-Point and 156-grain Sharpe solid bullets designed for this cartridge. More than 10 different powders were tested and rejected by the author before Winchester undertook on its own initiative the development of this Magnum cartridge. Among the things which these makers definitely proved was that their long-accepted custom of manufacturing hollow or semi-hollow-base bullets was not practical for velocities such as were sought and which for the most part had been experimentally achieved with handloads. Working with pilot guns built to handle a working pressure of 35,000 pounds, one of which was proof-tested by the author with 200 loads developing Springfield rifle pressures, Winchester began experimental work. Numerous cases were manufactured—cases with normal heads, extra thick heads, normal side walls, extra-thick side walls, flat inside the powder chamber of the brass case and later a dished or cup-shaped drawing. They experimented with numerous bullets, including the majority of cast types, both the Keith and the Sharpe.

The Sharpe bullet was based on the Keith, designed by Elmer Keith of North Fork, Idaho. It was somewhat lighter, and different in every dimension from the Keith form, having been definitely engineered to fit the Smith & Wesson .357 MAGNUM and .38 Special barrel. It has approximately ⅝ the bearing surface of the Keith. The Sharpe bullet is so cast that it does not require excessive resizing. Most Keith bullets are cast oversize, and when properly sized to meet the



A rabbit hit in the south end while going north is generally messed up. Note the explosive effect on this running bunny. A bullet from a .357 Magnum revolver struck him in the left rump, completely destroying the left hind quarter and thoroughly gutting the animal on the spot. (The left hind foot was not lucky for this rabbit)

barrel specifications show much greater bearing; in some cases, upon actual measurement, they present approximately 50% greater surface to the bore than the Sharpe type.

Winchester, in experimenting with this cartridge, rejected both the Keith and the Sharpe, adapting to a certain extent a number of the Sharpe en-

Another deer killer meets his doom. This twenty-six-pound female cat was shot in the left shoulder with a 146-grain H. P. Sharpe bullet, velocity 1600 f.s., in the S. & W. .357 Magnum revolver. The bullet, ranging through the animal and destroying bone and tissue, came to rest near the base of the spine, still within the body. Entrance hole approximately .45 caliber. Note closeup of wound

gineering ideas, thus explaining why this bullet is called the "Sharpe type" of contour. The Keith bullet cannot be given the velocity possible to other bullets of the same weight, because of its excessive bearing, although it is ballistically one of the best shaped bullets on the market.

This .357 Magnum cartridge is an excellent killer for several distinct reasons. It has greater velocity than ever before attempted with any handgun, superior energy and high rotation velocity, which, combined with the bullet contour, is responsible for its shocking effect upon tissue. It is opening an entirely new field for the handgun shooter, and within the next few years there will be many improvements and steppings up of existing handgun cartridges. The author warns against the conversion of existing handguns, even of the heavy-frame type, to handle this .357 cartridge. It has been experimentally done, and the experimenters encountered the same complications as Colonel Wesson did in his development of the ultra-magnum revolver. They are too numerous to mention and shall not be described here.

The stepping up of ordinary cartridges beyond recommended pressure limits has always been fraught with danger and should be seriously studied by each handloader before he attempts to solve the problem. The author does not recommend this, simply because it is impossible to do so without a thorough understanding of each individual case. It can be done, but it is always at your own risk.

It should be borne in mind that pressures beyond the normal recommended limits mean a much higher chamber and barrel temperature. They bring out problems of fouling with both lead and metal-jacket types, and in many cases cause serious erosion. In no case can the shooter depend upon Magnum ammunition to deliver the normal barrel life of standard-pressure types. Experimenters working on .22 super-velocity cartridges have learned much of Magnum limitations. One experimental rifle cartridge, to the author's knowledge, developed a velocity in excess of 4500 f.s. with a 56-grain bullet. This particular combination, using straight nitrocellulose powder, showed serious barrel erosion in 100 rounds and was promptly abandoned.

With the advent of the new Winchester Model 70 rifle in .300 and .375 H. & H. Magnum calibers, rifles of more than normal power are made available. The .375 H. & H. is the most powerful cartridge manufactured in America, and we predict that handloaders will do a great deal of experimental work with these numbers. Bear in mind that in working with extra power, extra velocity and similar projects, unknown factors enter into the case and every precaution must be maintained to see that bounds of safety are not exceeded.

In addition to actual power, handloaders during the next few years will be experimenting with

ultra-high velocity developments in both rifles and ammunition. Already we know of a great many of these now under way, but at the present stage of development little can be said about them.

The United States Government is also interested in ultra velocity and the tremendous power achieved through velocity alone. At Springfield Armory early in 1937 James V. Howe, author of *The Modern Gunsmith* and noted toolmaker and experimenter, took charge of development work in an effort to pass the 5000 f.s. velocity figure. On February 12, initial results were achieved. Velocities were recorded of 5122 f.s., using special materials, special barrels, and other special equipment. These tremendous figures were topped with an additional shot which registered 7100 f.s. Details of this experimental work are an Army secret at the present time, but it clearly indicates that the ultra-high velocity of which we have dreamed for years may soon become a reality. Jim Howe tells the author that using the same methods of barrel- and bullet-making employed for previous tests, he believes that there will be no difficulty in achieving 10,000 f.s. While we cannot reveal the weight of the bullets used in this experimental work, even should the 10,000 f.s. figure be reached with a tiny 48-grain bullet equal to the Hornet or .220 Swift, it would develop 10,217 foot-pounds of energy, and what this bullet would do at such velocities can only be judged in theory at the present time. Without a doubt, it would produce instantaneous kills through nerve shock, similar to electrocution. Howe states that high velocities were achieved with normal Springfield pressures, and that the ammunition and barrels can be produced at a cost but slightly higher than that of present barrels and Springfield ammunition. The 7100 f.s. cartridge case in the author's files shows no signs of excessive pressure.

At the time of going to press, Howe and his assistants had recorded a velocity between 8500 and 9000 f.s.—the highest in the world. Experimental work by the Government will continue.

Thus do we progress through research. There will be more of this, and the handloader will contribute his share to the development of the firearms industry. This work always begins with the stepping up of existing loads in the better-known calibers. There is just one caution:

Do not carelessly attempt to Magnumize your rifle or revolver. First look the situation squarely in the face and determine whether the increased power will prove usable. If you must Magnumize, then go ahead—*AT YOUR OWN RISK.*

XXXI

SHOT LOADS FOR REVOLVERS

By J. G. Kirk, M.D., *Listowel, Ontario, Canada*

THE use of shot in revolvers and pistols is by no means a new idea. The muzzle-loading horse pistol was loaded with small rocks, nails, scraps of metal, and in later years with large shot; and the records indicate that at close range it was a formidable and effective weapon. In recent years, attempts have been made to shoot shot from rifle barrels, revolvers, and other firearms, the results generally being far from encouraging.

There was a time when all the American ammunition makers included shot loads in their line for the majority of rifle and revolver cartridges, particularly those having a straight shell. These proved entirely unsatisfactory, as the rotation of the charge imparted by the rifling caused the individual pellets to fly off on a tangent, thus creating a "cartwheel" and completely shattering the pattern, so that with a perfect hold one would find, at a normal range of twenty yards or so, a hollow-center pattern which would permit the total escape of game as large as a rabbit. Accordingly the ammunition makers abandoned these loads and today they are rarely found.

There is, however, on the American market, one particular shot load designed for the Thompson sub-machine gun and loaded only by the Peters Cartridge Company. This cartridge can be shot in the Model 1917 Colt or Smith & Wesson Army Revolver as a repeater, or in the .45 Colt Automatic Pistol as a single shot, the cartridge being loaded with too great an overall length to be accommodated in the magazines. This particular cartridge was not designed for killing purposes. Its chief use was in the machine gun, to be fired over the heads of a rioting mob, giving the noise and psychological effect of regular ball cartridges but creating little or no damage at long range, thus eliminating the danger to bystanders or distant windows.

In discussing this .45 Peters-Thompson shot cartridge in the March-April 1933 issue of the *Journal of Criminal Law and Criminology,* Philip B. Sharpe writes as follows:

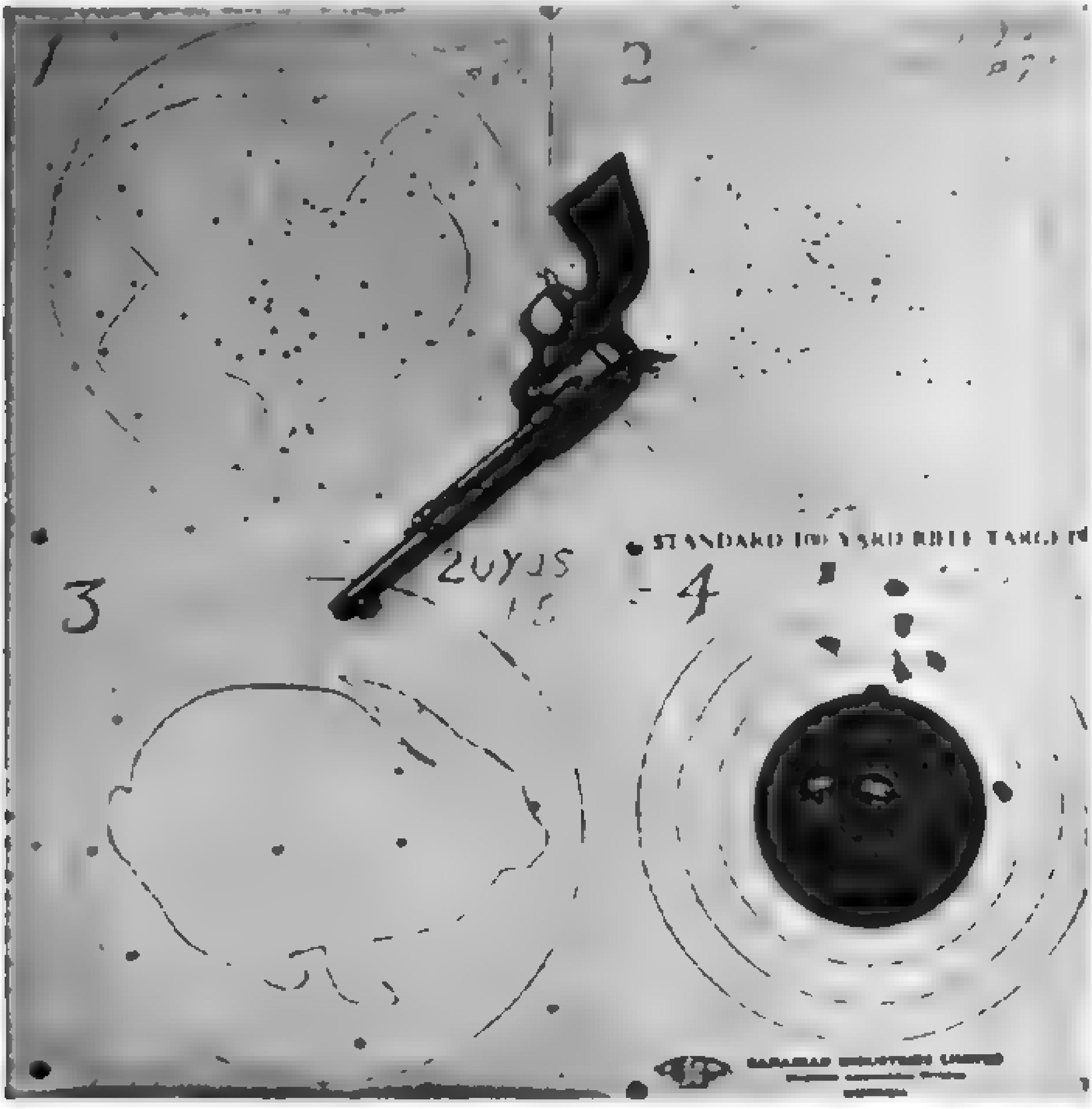
". . . This ammunition requires the use of a special 18-shot box magazine, Type XVIII, and consists of a waxed paper bullet or shell containing about 150 #8 Chilled shot, propelled by what appears to be Ballistite shotgun powder. A perforated tin cup separates the shot charge from the powder and maintains the alignment in the bore until the charge leaves the muzzle. Where it goes afterward is a mystery: tests fired at 25 feet fail to locate the cup on the Colt silhouette target."

Writing further in the December 1934 *Rifleman,* and describing the use of this cartridge in the sub-machine gun, Mr. Sharpe writes: "The shot load spreads over the community and loses its initial power rapidly. It is designed for riot work where the primary idea of the police is to force back the crowd. The rifling in the barrel scatters the shot so that it is impossible to pattern it at more than 15 or 20 feet when single shots are fired. If fired in bursts of from five to ten cartridges, however, the pattern shows extremely wide but reasonable dispersion of the charge."

A gentleman named Bud Dalrymple, of Scenic, South Dakota, has for many years been rebuilding revolvers and rifles to handle a charge of shot effectively. For revolvers he prefers the single-action Colt in length from 6½ to 9½ inches. He uses miscellaneous rifle barrels which have been discarded because of wear or pitting, using the muzzle sections, cutting them off, reboring them and inserting a choke. Some two years ago he made up a very expensive pair for a New York man to be used for stunt shooting, particularly on aerial jobs. For this work he used the Colt .44 Special revolvers with 6-inch close choke barrels which were later nicely engraved, silver plated and otherwise decorated. For this work he inserted a set screw in the hammer to act as a stop, so that when the hammer was jerked back sharply for quick shooting, it would not break either the hand or the cylinder stop. Dalrymple uses these guns in his own shooting with various large sizes of shot, often running down coyote pups with his horse and shooting the pests from the saddle.

The deer hunter frequently has chances at grouse, rabbit or other small game which he may

desire for food, and usually he is not sufficiently expert with a .22 pistol to hit the vital parts of such small game. In even the more remote regions, grouse are becoming exceedingly wary. The hunter may not see them until he flushes them a few steps away, and there is no chance to shoot



Smooth bore shot revolvers can be made to perform with both bird shot and large size pellets. The target on the lower right corner was shot with full charge .45 loads in the smooth bore barrel by the author of this chapter

at the head of a bird with a heavy rifle. A shot pistol is extremely useful for this work. It can be drawn and fired very quickly, and up to 20 or 30 yards it can be made extremely effective and usually produces quick kills. In shooting rats or other pests about a place, the shot pistol is in a class by itself. For the experimenter who likes to shoot at aerial objects, this type of gun offers an interesting pastime. It is more encouraging to the beginner because hits will be made far more frequently than if the regular pistol were used. It is also reasonably safe to use—something which cannot be said of other guns when bullets are shot into the air.

The results with shot revolvers depend upon three distinct features—the man, the gun, and the load used. Ordinary shooting ability is all that is required to do good work with a shot pistol. Anyone who can do fair shooting with a rifle can get results with a smooth-bore pistol, but he must be careful in his choice of load and method of loading. Any large-bore revolver with a barrel length of from 5½ inches up to 7½ inches can be adapted to the use of shot. The greater length is always to be preferred, as it produces much better patterns when properly built. There should, of course, be some choke in the barrel. Ten to twelve thousandths constriction seems to work best for small shot, although pellets as large as BB will work better in the more open boring.

As to the load itself, there are a number of revolver cartridges which are suited to reloading with shot: the .45 Colt, the .455 Colt, the .44/40, the .44 Special and .44 Game Getter. Of these the .45 Colt is best. It has the largest capacity to hold powder, wads, and a reasonably heavy charge of shot. The .44 Game Getter has more space, but its disadvantages more than outweigh its advantages. The .45 has a heavy straight side case, stands reloading well, and rarely needs resizing unless very heavy loads are used. The .44/40 can be used, but since it has a bottle neck it is by no means as easy to handle; nor does it produce as uniform results.

The following reminders regarding the loading of the .45 Colt may well be applied to the loading of any other shells mentioned. The case of the .45 comes in two lengths, the regular length and the shorter case often known as the .455 Colt. The long shell is best. Shells designed for black powder have no cannelure about the body and are probably better, but regular smokeless shells are entirely satisfactory. If shells you use have been fired in another gun, try them in your chamber before loading. If they are too tight to chamber easily, full-length resizing will be necessary.

The non-mercuric, non-corrosive primers should always be used with the smokeless powders when available. No cleaning of the gun is ever necessary, and the cases last for a great many loadings. Pistol primers should always be used. The large-size rifle primers fit the pocket and may be used in a pinch, but, as in other handgun loadings, they are too powerful in their ignition and in balance for the load. This is particularly noticeable in shot loads, as scattered patterns will invariably result. Misfires will also occur because the rifle primers have too stiff a cup, thus offering excessive resistance to the comparatively light blow of the revolver hammer. Be sure you use the right size of primer. This depends entirely upon the make of shell you use and the make of primer. In older days the proper size was "#2½," but today, with ammunition makers developing special designations for their non-corrosive primers, it is best to consult a catalog of the various ammunition makers before you make your decision.

A variety of powders are available. One of the best I have used is the Du Pont Oval Shotgun, a dense progressive-burning powder. It does not take up too much space in the shell, and handles heavy loads of shot extremely well, burning properly in the short barrel lengths of the handgun. The bulk powders such as Du Pont #80 Rifle and Bulk Shotgun occupy too much space. Du Pont Pistol Powder #5 has given excellent results, and while I have not tried out the new #6, it should also be extremely effective. Hercules Herco Shotgun is ballistically similar to Du Pont Oval and may be used in the same charges. Red Dot, a new Hercules Powder for shotgun use, gives excellent results if used in charges slightly below the maximum. I, personally, have never tried Bullseye Pistol Powder.

It is extremely important that the shooter experiment with his powder charges, as the proper charge to fit his individual barrel will be found only by trial and checking of the patterns. An even pattern is much more desirable than maximum penetration, and it will be promptly found that too much powder results in patchy and blown patterns. The following charges used with a load of 100 pellets of #7½ Chilled have given extremely good patterns for the writer and a penetration of ⅜ to ⅝ inch in pine:

Du Pont Oval	7½ grains
Du Pont Pistol #5	5 grains
Hercules Herco	7½ grains
Hercules Red Dot	7 grains

Mr. Dalrymple uses Du Pont Oval but has also used Dead Shot Shotgun and #80 Rifle. He reports that Bullseye works well in the short .44/40 case, as it requires much less room.

In loading shot revolvers, perhaps the most important single step is the choice and assembly of the wads. These must make a gas-tight seal between the powder and the shot charge, both in the cylinder and in the barrel. To insure this the wad should be slightly greater in diameter than the largest part of the bore.

A stiff cardboard wad is first rammed down on the powder. A measured uniform pressure on this wad makes for regularity of combustion. This cardboard wad is followed by a thick greased felt wad and then by another stiff card wad. The felt wad is easily cut from a piece of an old felt hat which has been immersed in a mixture of beeswax and tallow. This mixture lubricates the bore and prevents leading.

The wad over the powder is about ¼ to $\frac{5}{16}$ inch thick. In my experimental work I have found that this seems to be the minimum thickness consistent with good patterns. Any attempt to make room for more shot by decreasing the amount of wadding leads to scattered and useless patterns.

The size of shot to be used will depend upon the purpose of the load. If for medium-size game or personal defense, BB pellets will be best. The

.45 with the usual load will hold 16 BB pellets. At 20 yards most of this will strike in a 20-inch circle and will penetrate one inch of pine. If for aerial shooting at small objects, #9 or even Dust Shot gives a good pattern and affords sufficient power to shatter even brittle targets. For general use on birds, rabbits or vermin, #7½ Chilled works best. This size runs about 345 to the ounce, and the .45 revolver will hold about ⅓ of an ounce. This load gives a dense pattern over a 20-inch circle at 20 yards. Penetration is approximately ⅞ of an inch. Larger shot, such as #4, has too great a spread in pattern density to be any more effective than smaller shot.

Grouse, cottontails and jack rabbits have all been killed with this load. Starlings, which are a pest in my section, have given valuable information as to the effectiveness of various loads. My record to date has been seven starlings with one shot. Up to 20 yards a clean kill on small game is reasonably certain if the hold is right. To attempt shots beyond that range is asking too much of that gun and is ineffective on the game, causing more cripples than kills.

In running the charge into the case, the shot should fill the case to within $\frac{1}{16}$ inch of the mouth. This leaves room for the stiff card wad over the shot to hold it in position. A really stiff card wad is absolutely necessary, as otherwise the recoil of the gun will cause it to buckle with disastrous results. The case should then be thoroughly crimped. Over this wad we need a much heavier crimp than usual to prevent the jolt of the recoil from spilling the shot from the unfired cartridges and also to help the burning of the powder by offering a high initial resistance.

Just a few words about the tools required to load shot cartridges. Very few are necessary. The regular loading tools may be made over to put the super-crimp on the case. A wooden rammer should be made to seat the wads and can easily be formed of a piece of hardwood or dowel stock. Wad-cutter punches can be had from the companies making reloading tools, and a complete set of straight line tools can be made by any machinist who is familiar with the use of a lathe.

The illustration on page 297 shows what may be expected at 10 or 20 yards. These are by no means selected examples. Barrels may even be bored to shoot considerably closer and to give a more even pattern. It is quite possible to obtain from 75 to 80 pellets of #7½ shot uniformly distributed in a 12-inch ring at 20 yards.

Number 1 shows a pattern of #7½ as placed in a life-size silhouette of a grouse at 20 yards. Number 2 shows a pattern of #7½ at 10 yards. At this range the load is almost too destructive when properly centered on small game. Number 3 shows a pattern of BB shot in an outline approximately life-size of a snowshoe rabbit. It would of course be effective, but there are altogether too few shots in this charge.

Can this gun be used for full-charge factory-loaded cartridges? Number 4 clearly shows what the gun might be expected to do in a pinch if these loads are used in a smooth-bore. That particular pattern was shot at 20 yards indoors under difficult conditions. Hold was at six o'clock. It will be noted that all the bullets keyholed or struck sidewise. This is a powerful load with sufficient accuracy for short-range shooting.

Some effective results with excellent accuracy can be obtained by using a handload with round balls of proper size to fit the bore. Mr. Dalrymple recommends the use of pure lead for these round ball loads, and states that they do not harm any of his choke-bored barrels. I have in my possession a target shot with one of Dalrymple's .45 smooth-bores with 7½-inch barrel, choke-bored. Seven shots were fired at 40 feet, all of them grouping in a 1½-inch circle.

The handloader has an excellent field for experimenting in the smooth-bore shot revolver. This gun is entirely practical and would be more widely used if its advantages were really understood.

XXXII

QUANTITY PRODUCTION FOR POLICE AND CLUBS

THE available handloading tools and equipment are not suitable for what is generally termed "quantity production." Any attempt to handload large numbers of shells without proper equipment quickly proves discouraging. Handloading of that kind requires different treatment and different tools.

Quantity production of handloaded ammunition began around 1900, when National Guard outfits throughout the country started to reload their .30/40 Krag cartridges with cast bullets in order to economize on ammunition expenses. At that time there were only a few tools on the market, all of them hand-operated types such as the Ideal tong, Winchester, UMC, etc. Accordingly, John N. Barlow of the Ideal Company set to work to solve this problem. The result was the famous Ideal Bench Loading equipment, which has been on the market for over a third of a century. Since that time a multitude of speed tools have been brought out, many to fall by the wayside. In 1909 Frankford Arsenal developed a bench loading tool, of which only thirty-four sets were ever actually manufactured. It was designed for handloading both the .30/40 Krag and the Model 1906 cartridges.

Need of Speed Tools. Today there is real necessity for these speed tools and for quantity production. The average police department gets no practice whatever with its various handguns. Not one police officer in a hundred can shoot with even mediocre success. Police departments do not encourage the training of their officers, a fact due chiefly to lack of understanding of the necessity for a reasonable training of their personnel, and to the high cost of ammunition. You cannot make a good shot out of anybody, be he police officer, military man, or civilian, by teaching him at the rate of less than fifty shots per year, and many hundreds of police departments do not even allow that amount of ammunition. In other departments the officers are invited to train, and a range is made available; but they must purchase their own ammunition, and a $35.00-a-week cop with a wife and family to support cannot afford to buy a box of police cartridges every week at $1.75 to $2.25 per box.

During the past decade there has been a growing tendency to recognize the necessity for target practice. Police departments have learned that handloaded ammunition is quite satisfactory for this purpose, and the cost is only a fraction of the expense of factory-loaded cartridges, even at the price quoted to municipalities, which are not required to pay the customary tax.

The average police department, for a reasonable initial investment in equipment, can get abundant practice at extremely low cost. The best way of doing this is to organize a special department, make a range available, make target practice compulsory, award medals to the officers; and, as a few cities are now doing, increase the officer's monthly salary in accordance with his ability to shoot. This increase may run from $2.00 or $3.00 up to $15.00. It costs the city comparatively little in comparison with its other police maintenance, increases the morale of the department, and gives the men a form of "promotion."

The first thing to do is to scour the department to locate a gun bug. One or two usually can be found in every police department. The most likely prospect should be trained in the art of handloading ammunition. In practically every city of any size, there are shooters who are gun cranks of the first water, and who specialize in handloading their own ammunition. These may be located through shooting clubs or through the local sporting-goods stores, which they frequently visit, thus becoming known to the various managers and clerks. An individual of this type is usually willing to donate his services to a police department to help it organize. Rarely does a department find it necessary to pay for such services. The gun bugs are an extremely fraternal clan, always willing to help.

The choice of handloading equipment is extremely important. The department should set aside a certain amount of money to cover the initial investment. It should have a complete line of bench loading tools, *not* the hand type. There should be a good grade of loading tool, capable of decapping, re-priming, full-length resizing, and otherwise preparing the case for the charge of powder. There should be a quality powder measure

and an accurate set of weights, with a sensitive balance, so that the powder measure may be checked at frequent intervals. The police officer selected by the chief as the handloading expert should be in exclusive charge. The handloading room should be in police headquarters and should at all times be kept locked, with one key in the possession of the chief or man on the desk, the other in the possession of the officer in charge. Definite instructions should be issued to all officers never to enter this room except on business, and then only with proper authorization from the chief or from the desk sergeant. Unless the operator is thus protected by rigid routine, the interference with his duties will be so great as to affect the quality of his work. With proper equipment this officer may be assigned to the job of handloading ammunition one day a week, and with regular weekly shoots of the entire department he should be able to keep it plentifully supplied with ammunition.

Just what type of tool should this officer have?

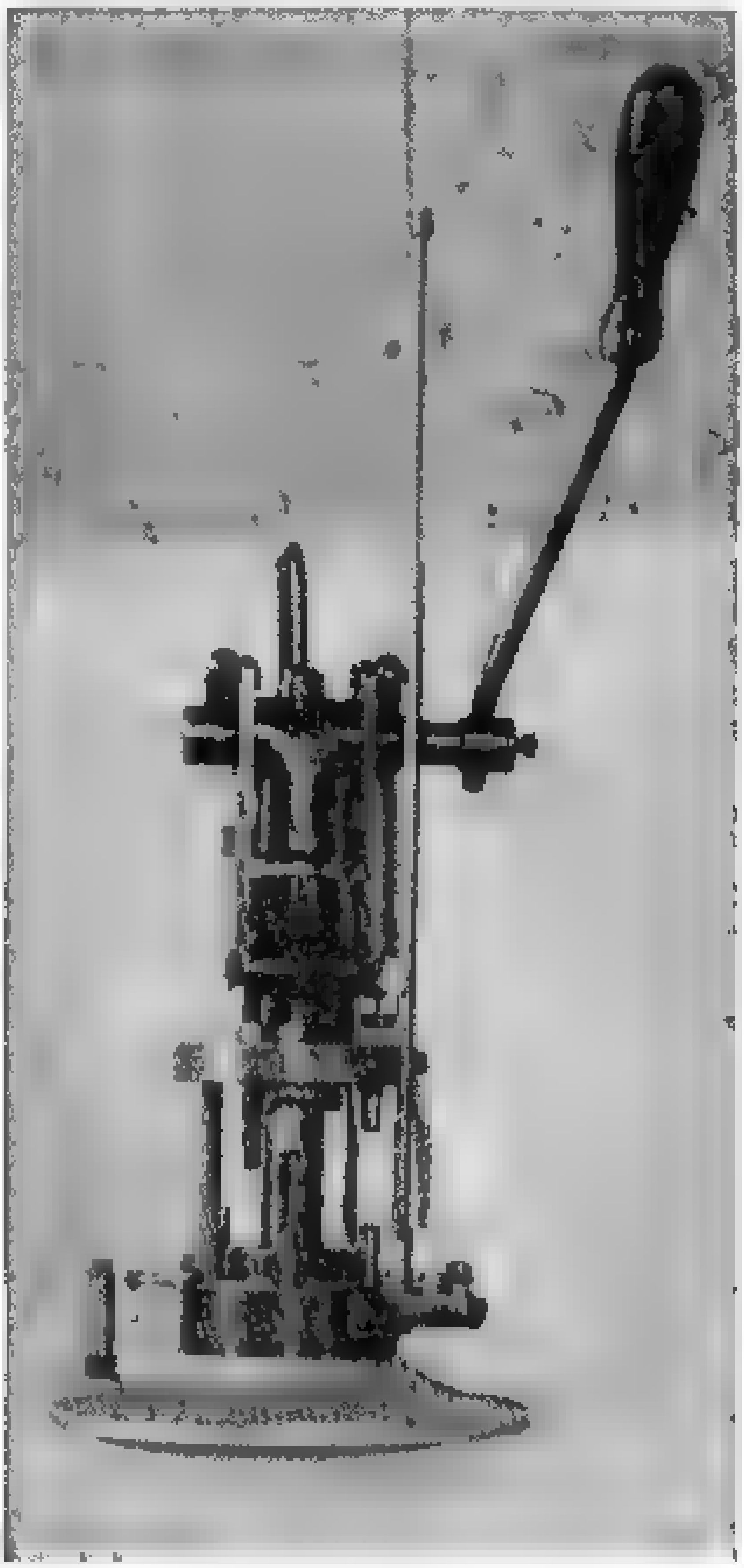
Star Machine Loader. There is the little-known but extremely handy outfit, the Star, made by the Star Machine Company of San Diego, California. Costing in the vicinity of $65.00, this tool will load approximately 500 rounds per hour, and do all steps in the handloading process except the casting of bullets. It was designed by C. R. Peterson. Application for patent on this tool has been made, and it is actually a *loading machine* rather than what is generally accepted to be a "loading tool."

In using it one mounts the entire unit on a small table or bench having a hole exactly beneath the register hole in the base of the machine. Loaded cartridges as they come from the outfit will drop through this opening into a box or other device beneath the bench. It occupies very little space and is easy to operate. The tool contains all the necessary resizing dies, de- and recapping tools, an automatic primer feed, built-in powder measure, and suitable bullet seater. The powder measure is non-

The loading room of J. B. Smith, of Middlebury, Vermont. In this workshop a handloader, who desired to shoot extensively, began what is today the largest custom loading business in the United States. In this room are loaded an average of about 6000 different cartridges each month—frequently more. In eighteen months Mr. Smith consumed about 135,000 of a certain make of .22 caliber bullets in addition to his other handloading. Note convenience of set-up of various tools used, also storage of bullets below work bench

adjustable, and therefore does not require checking with powder balances.

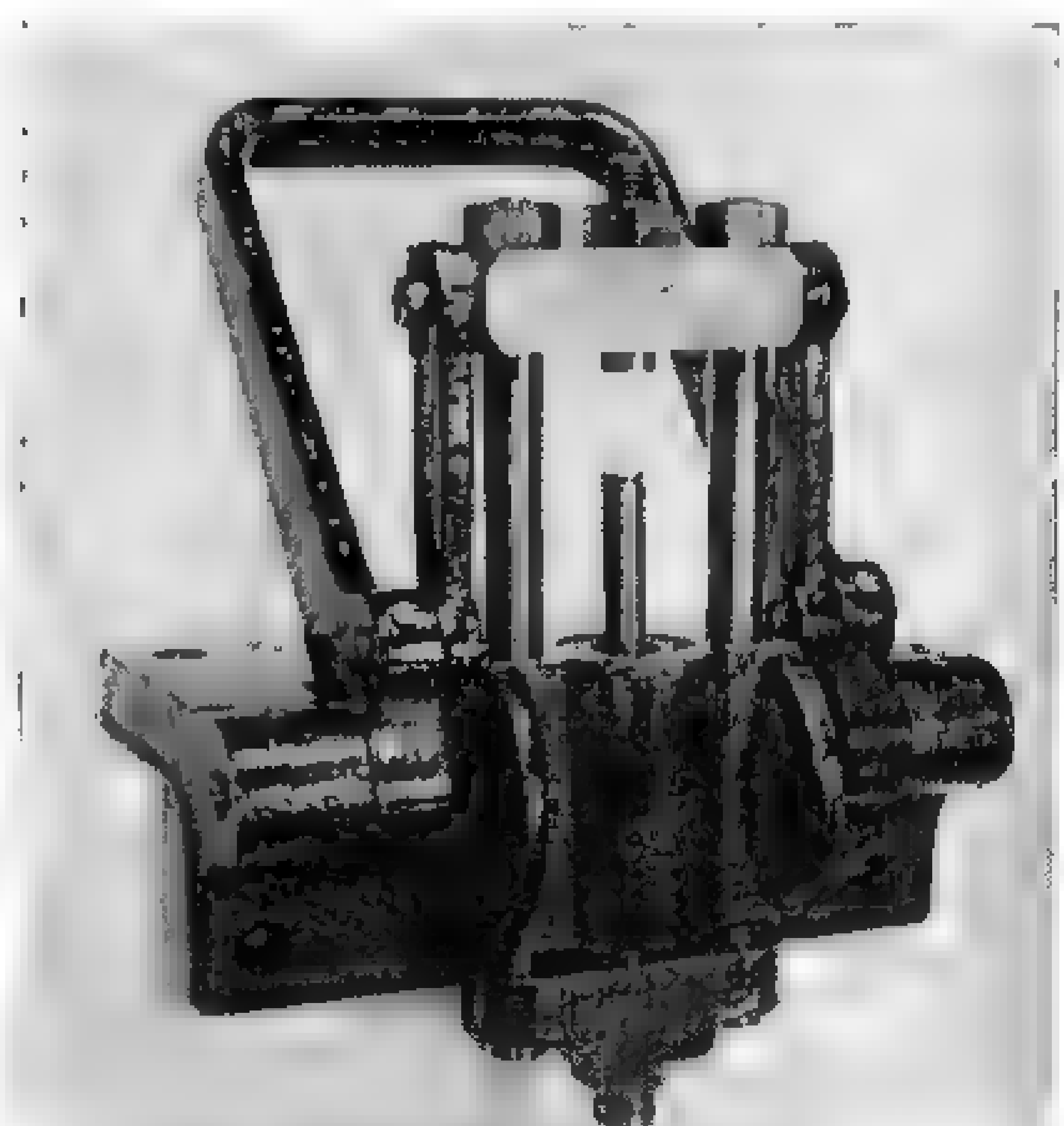
The operator inserts an empty shell into position on a rotating turntable, moves it one notch, pulls



The Star progressive loading machine, designed for completing a round of .38 Special ammunition at each throw of the lever

the operating handle downward, and then releases it. This punches out the fired primer and full-length resizes the shell. The operator then inserts another fired case, rotates the turntable an additional fifth of a turn, and repeats the handle operation. The second shell is decapped and resized, while the first shell, sitting under another set of dies, is expanded slightly inside, the crimp properly removed, and the case furnished with a new primer, the operation being entirely automatic.

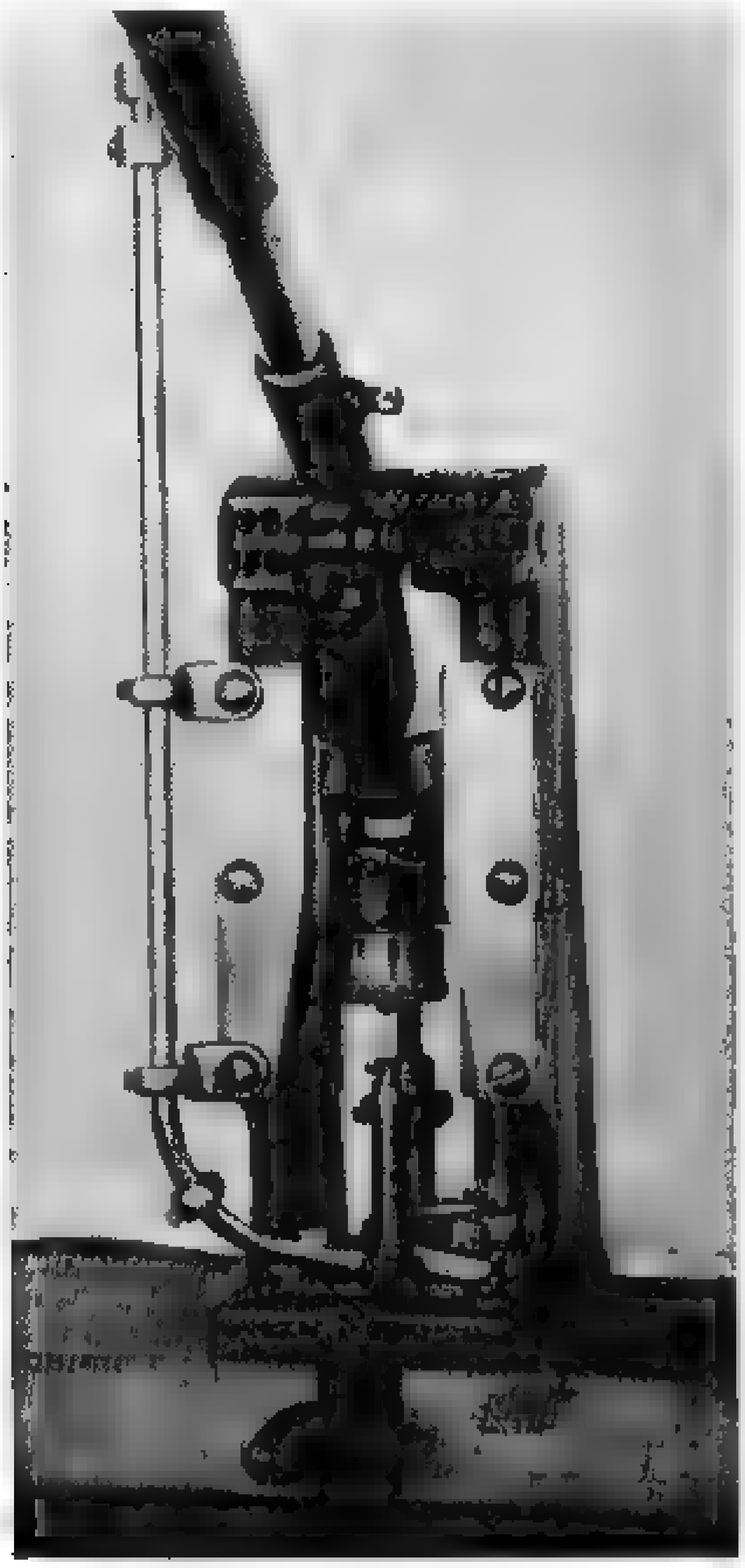
A new shell is then inserted and the process repeated once again. Number one shell this time moves beneath the automatic powder measure, and a suitable charge is run into it while case #2 is reprimed and #3 decapped and resized. A fourth case is then entered into the machine, and at the same time the proper bullet is balanced over the mouth of the cartridge case #1 now on the rear of the machine. Operation of the handle takes the other cases through the corresponding steps, seats the bullet in #1, and puts on an excellent and uniform crimp. As another cartridge case is entered into its proper turntable slot, #1 drops through the hole in the base of the machine and thence through the hole in the bench. A receptacle beneath the bench in the form of a padded slanting incline will conduct the loaded cartridges to some form of container, where they may be inspected and packed in boxes or used in bulk for shooting purposes. From that time on, each throw of the operating lever and the feeding of a new fired cartridge case results in the discharge by the machine of a completely loaded cartridge. All that is necessary is to feed in the shells, place a bullet on the top of the cartridge case containing the powder charge, and complete one cycle of the operating lever. The dies are adjusted for this tool at the factory, but may be changed or altered by releasing their lock nuts and removing them from their proper position in the loading instrument.



The heavy bench resizing press of the Frankford Arsenal, famous loading tool set, sold some years ago to members of the NRA. Note sturdy construction and horseshoe operating lever

This machine is really capable of precision work and is quite simple to operate. It will soon save its cost in loaded ammunition, and an operator

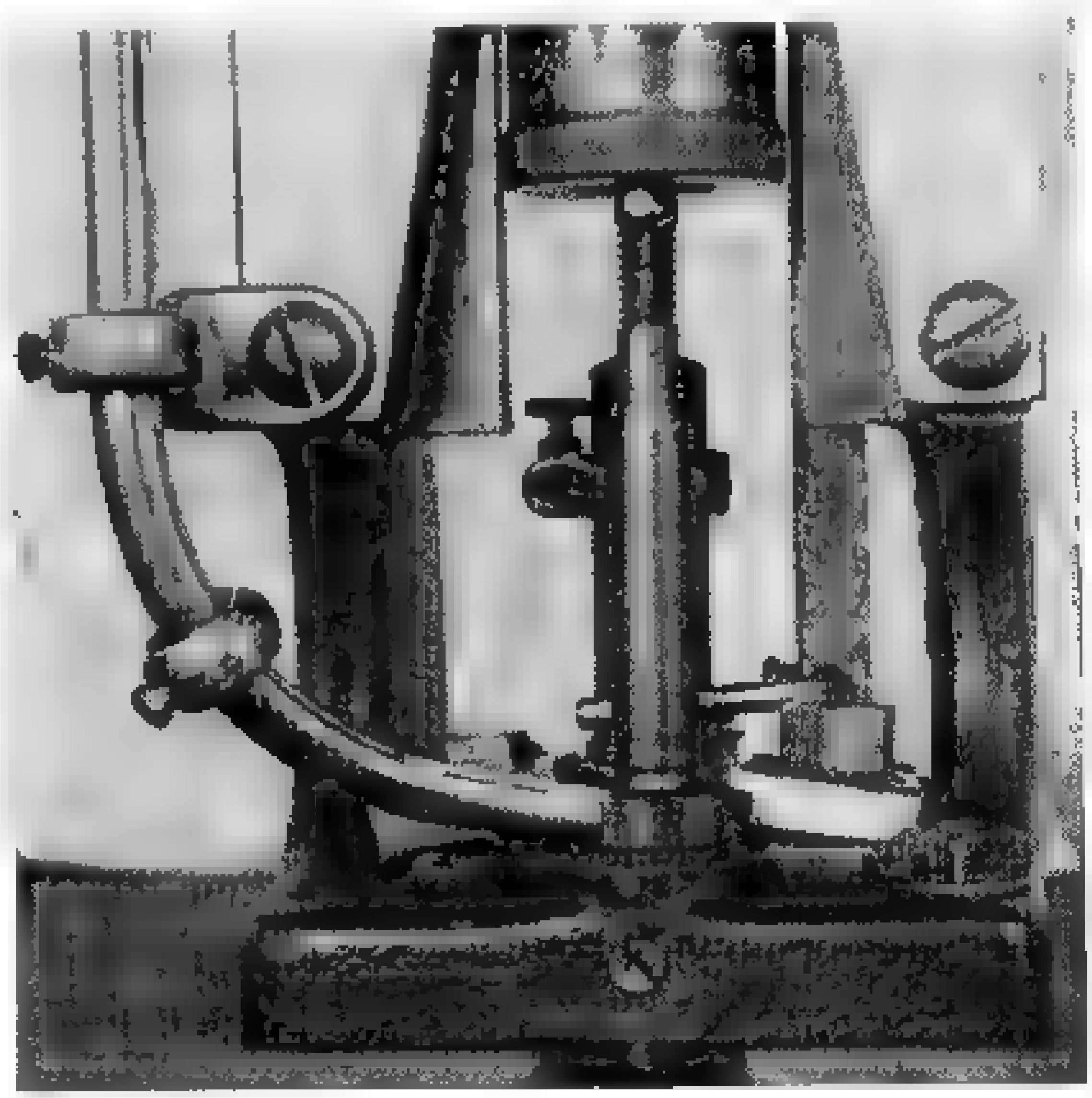
equipped with it and a proper supply of bullets and primers could easily turn out 3000 cartridges in an eight-hour day. He might even do better with proper training.



The latest version of Ideal Armory loading press equipped with automatic primer feed as illustrated

The primer feed on this machine is extremely interesting. The primers are stacked in a brass tube, cup-side up, and in this position are fed one at a time by a horizontal slide to their proper position beneath the pocket of the resized cartridge case. While being held there in a proper fitting guide, the final movement of the operating lever causes a punch, designed to fit the particular primer being used, to rise up through this guide hole and force the primer to its proper depth in the pocket of the case head. Since there are two distinct sizes of commercial handgun primers, both in the same caliber of case, it is necessary to equip the machine for the particular primer one desires to use. These primers have a diameter of .175 and .210 inches. To change from one to the other necessitates three additional pieces of equipment and about three minutes of labor. The magazine guide is removed, the primer feed slide lifted out with the fingers, and the primer seating punch and its bushing removed by means of a small spanner wrench or screw driver. The proper size is then placed in position, the operation is reversed, and a magazine of proper size to handle the additional primers inserted in its socket.

Loading this magazine is a simple job. The tube for primers is loaded with an auxiliary feed, and through an ingenious arrangement the charging of the magazine is merely a matter of a minute. To charge the magazine one pours the primers loosely into some holder such as a cartridge-box cover. Some of these will fall right side up. The loading tube is held in the fingers much as a pencil would be handled, and is slit on one end so that it may be forced over a primer. When the upright primers have all been picked up, one merely shakes the box gently for a couple of seconds, which causes additional primers to right themselves. As these are picked up the process is repeated. A hole drilled through the side of this magazine charging tube in the opposite end contains a cotter pin, and primers are picked up until the column reaches this pin. It is then inserted

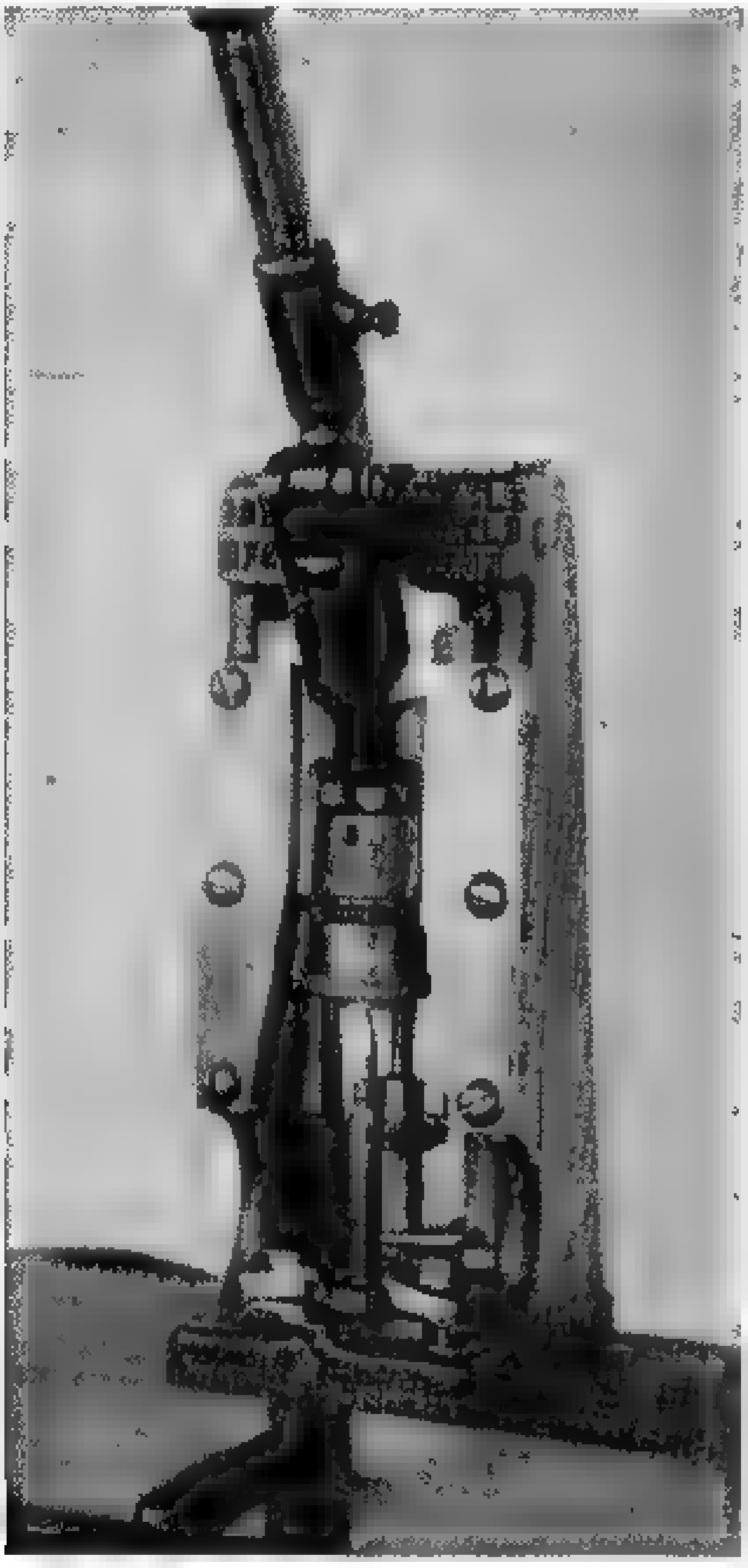


Close-up of the Ideal Armory press showing primer feed tube

over the magazine tube on the machine, the pin withdrawn thus causing the column of primers to drop from the charging tube into the magazine. To prevent spilling, the top of the magazine tube

is concaved and the end of the charging tube is beveled to slip into it. The cotter pin is used to free the last primer, being held by the jaws in the opposite end if necessary

With the magazine filled, a special rod is slid into the open end of the tube to add sufficient



The Ideal Armory press set up for bullet seating in the .30/06 caliber

weight to cause uniform feeding of the column of primers and to prevent jams. The height of this rod in the magazine tube indicates when the primers are running low and enables the operator to recharge it. Should he neglect to do this, the end of the rod will drop into the primer feed slide, thus locking the machine and preventing the loading of cartridge cases without primers. It is a very excellent instrument.

Should it be desired to load assorted kinds and charges of powders, additional powder-measure slides can be obtained to fit the tube. The hopper of the measure should be checked each time the primer magazine is charged, to insure a plentiful supply of propellent in the loaded cartridges. This powder measure is equipped with an automatic vibrator which settles the powder charge to the capacity of the metering slide at each operation of the lever, thus insuring uniformity of charges.

Pacific Bench Loader. Another highly practical tool is the Pacific bench loader. This can readily be adapted to either rifle or handgun cartridges through the addition of the proper dies and other parts. In the hands of a skilled operator it is capable of extremely rapid operation. One of these loaders has been used by the Los Angeles Police Department for several years, and in that time more than half a million handgun cartridges have been loaded with it. The Pacific is described in detail in Chapter XXII.

With this tool it is necessary to use a powder measure, and a powder measure should always be checked at frequent intervals by throwing an occasional charge and weighing it on a suitable balance. The cartridge cases should always be stacked in loading blocks made by boring suitable holes in a block of soft wood; soft wood is more practical than hardwood as it is somewhat lighter to handle and fully as serviceable.

To simplify the manufacture of these loading blocks, several of which should be on hand, one may bore the holes of proper diameter to allow the free passage of the head of a cartridge case through a one-inch board, the edges of which have been beveled slightly to eliminate splinters. To the bottom of this board may be tacked, or glued, a sheet of thin fiber or reasonably stiff cardboard to prevent the cases from dropping through. The block should have a capacity of at least 50 cartridges in rows of five and ten. As the charges are run into the individual cases they are placed in the loading block and the filled block held to the light to inspect the contents. This takes but a moment, and any case having an excessively large or small charge will be quickly noticed, and may be picked out.

With the cartridge cases properly charged with powder, one is ready to seat bullets. The combination resizing and decapping die is unscrewed from the arbor and replaced with a similar-appearing unit known as the bullet-seating die. The operating lever is lifted, thus raising the shell holder and forcing the cartridge case and bullet into the seating die, where the bullet is pressed home to the proper depth and the crimp applied. The lever is then dropped downward, withdrawing the now fully loaded cartridge, which is lifted free of the shell holder and dropped into a conveniently located box. Notes in the author's load-

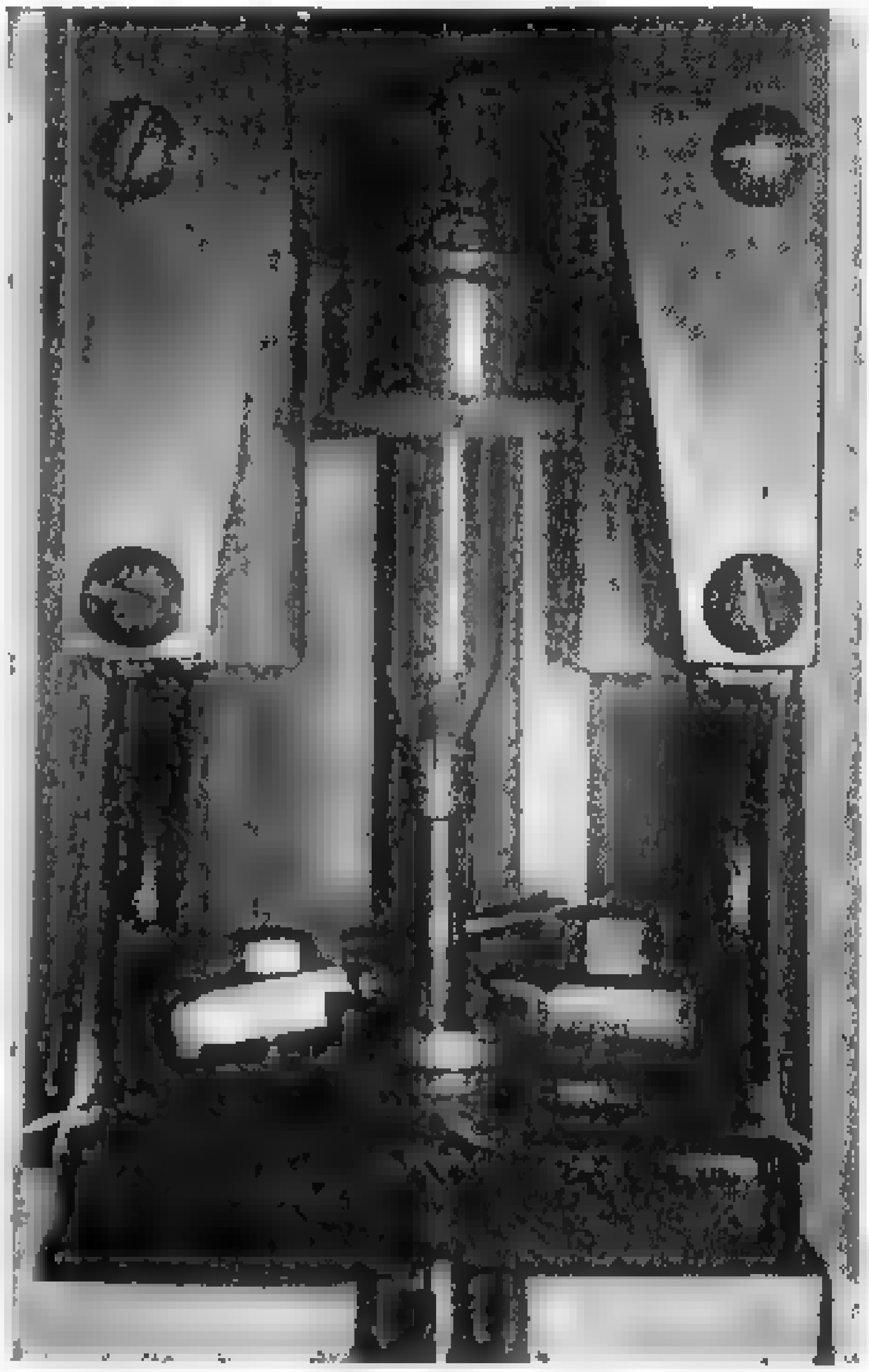
ing file give an approximate idea of the speed of this tool. Tested without priming the shells but resizing only .38 Special Peters cases, three 10-minute runs showed an average of 135 per 10-minute stretch, or 403 cases in the half-hour period—a rate of over 800 per hour. This test was run in resizing cases for a friend who desired to do his own priming.

Similar tests, which included the hand insertion of primers in the seating-punch guide, the test being conducted for uniform results rather than speed, show approximately 200 in a half-hour period. With the automatic primer device this was increased to about 375. The seating of bullets in a test in which uniform results were desired shows an average of about six minutes and a maximum of six and one-half minutes to seat 50 bullets—a rate of nearly 500 per hour.

Ideal Armory Outfit. The Ideal bench loading outfit is another excellent piece of equipment, and is effectively described in the *Ideal Handbook*. There is no necessity, therefore, for repeating the description here, as this book is designed to give information essentially unavailable in manufacturers' catalogs. The Ideal bench type, or the armory type, as it is often called, may be obtained with an automatic primer feed which is reported to be thoroughly reliable.

Frazier Multiple Loader. Another extremely interesting tool, which is not thoroughly known or understood, is the Frazier, described in Mattern's excellent book on handloading published in 1926. This tool is designed for loading rifle cartridges and is in some ways unique. The author has never seen one of these tools and has no information in his files concerning its maker or as to whether it is still available on the market. Like the Ideal bench type, it accepts cases one at a time, decaps and full-length resizes them. The Frazier tool uses a hand primer feed. The cases are inserted into a round drum which holds 48. The primers are dumped on a smooth plate which covers the case heads, and are fed by sliding them with the fingers over their respective holes until they drop down in proper alignment with the primer pocket. The drum is then inserted in the machine and the operating lever forced downward, which seats two primers at a time. Following this, the drum, still containing the cases, is turned over and a powder charge run into each by means of a Bond, Ideal or other powder measure suspended on a swinging arm. As the contents of the drum are completely charged with powder, the bullets are dropped into the drum holes to meet the case necks, and the operating lever again worked, seating the bullets two at a time. Between movements of the operating lever it is, of course, necessary to hand-rotate the drum to the next pair of cartridges.

The Jordan Bench Press. A recently designed tool capable of excellent performance made its appearance at the 1935 National Matches at Camp Perry. Designed by L. W. Jordan of the Union Auto Specialties Company, of Brookville, Pennsylvania, this tool shows originality chiefly in that the good points of various other tools on the market have been combined into a single instrument with a few additional features. It may some day be equipped with an automatic primer feed. At present none is available. This tool is described in detail in Chapter XXII.



The Ideal Armory press set up to full-length resize cartridge cases and decap at the same time. Tool set up in .38 Special. Note shell holder clamped by means of special clamp nuts and steel fingers

Schmitt Model #12. The chapter on "Quantity Production" would not be complete without a description of the Schmitt Model #12 tool designed and manufactured by C. V. Schmitt of Minneapolis, Minnesota. Schmitt has been building loading tools for more than ten years, and has hundreds of them in daily use by police departments or clubs. His machine is capable of greater accuracy of precision loading than any tool thus

far mentioned, with the possible exception of the new Jordan and the Potter Duplex. This, too, is described in Chapter XXII.

The Ideal Armory type operates with the cartridge cases held in a vertical position, as do the Frazier, the Jordan, the Frankford Arsenal bench type, and the Star. The Pacific operates at an angle slightly off the vertical. The Schmitt, on the other hand, functions in a horizontal plane; but this is fully as satisfactory, as speed is not the objective. There is, of course, less danger of spilling any of the powder charge when the case is moved in a vertical plane than when it is horizontal, but the author has loaded several hundreds of assorted cartridges with a Schmitt tool without a single casualty so he believes that this objection will not affect the careful operator.

Police Departments and Clubs. The operations just described essentially cover handgun loads for police departments. They may be as readily applied to club-operated loading equipment available to various members; they may also be applied where handloaded ammunition is sold through the club to its own members. We have not included a description of bullet casting, as many clubs prefer to purchase metal-jacketed bullets for rifle use or to cast bullets previously assembled by some individual who has specialized in this subject.

For the police department or club that prefers to do its own casting of bullets, certain equipment should be made available. A gas furnace is an excellent aid, though an ordinary gas stove serves the purpose well. If available, a good single-burner gas plate may be used. The casting should be conducted in a room entirely separate from that in which the loading is done, or at least in a far corner, since it necessitates the use of fire and thus increases the hazard, particularly if ammunition, powder or primers are stored nearby. One should, therefore, use extreme care in selecting a place for bullet casting, particularly if for a police department or shooting club. If police officers insist upon doing this work themselves, the operator in charge of loading can undoubtedly arrange facilities in a basement, eliminating the necessity of using the loading room. It is extremely doubtful if the fire inspectors would permit the police to operate a loading room in which a stove had been placed—for obvious reasons.

It is possible to obtain the so-called armory moulds of the gang type, in which from three to a dozen bullets are cast at a single pouring. The author has never used any of these, and while some of his friends have had the experience, the idea does not appear to be practical; unless one can load ammunition with a reasonable degree of precision, one might as well leave the subject entirely alone. Handloaded ammunition can be no more accurate than the bullets. Accordingly, it is wise, if multiple moulds are used, to confine them to the so-called double-cavity types. These perform with reasonable accuracy, and since bullet casting is never speedy, the results should be satisfactory enough. The operator will do well to read the chapter on bullet casting elsewhere in this book; it will give him all the essential information. Quantity production by individuals and clubs is entirely practical, and permits of a far greater amount of actual practice at a minimum expense.

If you insist upon using multiple moulds you will find some excellent specimens manufactured by major companies such as George A. Hensley, Ideal, and Fielding B. Hall. Shortly before this volume went to press, Mr. Hall sent through a collection of multiple bullet moulds for examination and we found them to be highly practical.

Hall sent through big moulds including a ten-cavity job, five-cavity, and some two- and three-cavity numbers. Prices run $5.00 for the double-cavity moulds up to $25.00 for the ten-cavity moulds. One of these sent through for tests was a three-cavity number. These multiple-cavity moulds are fitted with either an individual standard type of pouring hole for each cavity or his special oblong cavity sprue cutter intended for use with a pouring ladle. This particular type does not work very successfully in any of the standard electric melting pots used, although it can be handled in a reasonable manner.

The technique of handling these large-capacity gang moulds is somewhat different from that used with the smaller types. It is necessary to have a large melting pot to carry the metal at a slightly higher temperature than that used for the smaller moulds. One should keep at least thirty to forty pounds of metal in the pot at all times. These large-capacity gang moulds are heavy and cannot be handled in the customary fashion. The ten-cavity Hall mould weighs seven pounds and is 15½ inches long; the blocks run 1½ x 2¼ x 6 inches.

The particular mould that we tested was for a 150-grain round-nose .38 Special bullet. The blocks are in three sections and the casting consists of two rows of five bullets each. The middle section remains stationary when the handles are spread apart, while the handles attached to the outer section of the block open up to permit the bullets to drop loose.

We found no serious trouble in handling this big mould other than the fact that it was rather tiresome to lift around; but a large two-by-four, conveniently placed to support the mould while pouring from a reasonably large ladle, relieved the strain considerably. Incidentally, the blocks should be rested on wood rather than on metal.

In one half-hour test, I cast 450 bullets; in another, 380. There were very few rejects, indicating that the conditions were just about right for proper casting. Incidentally, this ten-cavity mould had bronze-lined cavities which aided greatly in dropping the bullet. The five-cavity mould that Hall sent through was cut in soft steel, and consisted of a single row.

This five-cavity number was for .45-caliber bullets. Since we use very few bullets in this caliber, the tests were not quite as extensive. The bullet weight was 220 grains, and this mould weighed 4½ pounds. Four of the bullets always dropped free, but one of the cavities situated close to the hinge insisted upon causing a bullet to stick, greatly slowing up casting with this particular mould. We were able to drop about 300 bullets in a half-hour, but with proper single-cavity moulds this speed can be more than equalled.

SPECIAL NOTE

Every effort has been made to correct this chapter on loading tools, but the latest data on new equipment as available at press-time has been covered in a new chapter in the supplement. It has been considered advisable to include the data on various tools, whether or not they still remain on the market. Loading tools, like firearms, have an exceedingly long life. Many tools made 50 years ago are still in service, and the chap who has a semi-modern tool and desires to acquire some other piece of equipment, finds a ready market for the tool he is discarding. Such tools can change hands many times. They disappear only when they are broken or when dies are no longer available.

XXXIII

TESTING BULLETS

NO handloading fan assembles loads which he does not care to test. This word "test" is peculiar. Its meaning depends entirely upon what you have in mind at the time you use it. If you throw cartridges into the gun, point the muzzle into the air, and yank the trigger, you actually are "testing." In other words, you are finding out whether the thing will go off and whether the bullet gets out of the barrel. Such a test, however, is hardly worth while. When the true gun bug refers to testing, he has something more definite in mind. The testing of ammunition depends entirely upon the purposes for which it is loaded: whether it is for rifles or for handguns; whether it is a target bullet or an expanding bullet, and whether one desires to learn the probable results on game or the degree of uniformity of grouping. At some time or other every handloader will want to test ammunition for all of these particular reasons.

A machine rest mounted on a sturdy shooting bench is excellent for testing your ammunition. The Weaver rest is quite inexpensive but highly efficient

Perhaps the most common test conducted by the handloader is that of accuracy. The beginner in the shooting game defines accuracy in a rather doubtful way. He takes the stuff out, sticks up a tin can at about fifty feet—which he is inclined to believe is fifty yards—and plinks a few shots at it. If he hits it, he claims that the ammunition and gun "are accurate." If he misses, the combination is "no good." Like as not, he does his shooting from an offhand position. He hasn't the slightest idea what he is doing, and the element of his own personal shooting ability apparently does not enter into his calculations at all. Such a test is absolutely useless.

The handloader, however, is usually not that type of shooter. He is an intelligent person who wants to know what he can do. He uses every possible artificial aid in testing his ammunition for accuracy, with the sole idea of obtaining the smallest groups and the greatest possible elimina-

tion of human error. This is the correct method of conducting tests.

The handloader who lives in the country is indeed fortunate. If he has available a private rifle range he is even more fortunate. Certain gun bugs gather in a group even when they live in the city, drive out of town to a suitable spot, find a place with natural facilities for safety, and arrange with the owner of the land to borrow or lease the property for a small sum. Here they may shoot to their hearts' content. They go ahead with the installation of a suitable rest.

Building a Shooting Bench. Perhaps the finest of accuracy tests, either with rifle or with handgun, can be conducted from a shooting bench. A bench of this type should be considered as a permanent installation, not a temporary or portable affair. If it is solidly built, the experimenter can use it as a base for a machine rest, several of which are available at a reasonable price today. There are shooting benches and shooting benches. The most solid is invariably the most practical. It should have four legs built of 4 x 4 spruce or hardwood, and the legs should be sunk from 4 to 6 feet into the ground; the greater the depth the more sturdy the bench is likely to be. Since it will stand roughly about 3 feet high, the timbers should be at least 9 feet long, not less than 4 x 4, and preferably 6 x 6 or 4 x 6. The portion of these legs which goes into the ground should be thoroughly treated with creosote, asphalt or some other wood preservative before insertion. A bench so constructed will last, exposed to the weather, for many long years.

A portable shooting bench is a very useful accessory for test work. This one, designed and manufactured for the author by E. C. Dyer of Portland, Maine, weighs fifty-eight pounds and is made of straight-grain maple with a soft pine top. The V-block is adjustable for elevation. The twin forward legs are bolted together at the bottom and form a more rigid support than a single front leg. No stool is used, as the seat is built into the rear legs. This folds compactly without loosening or removing any bolts and can be carried in a car to a suitable shooting range

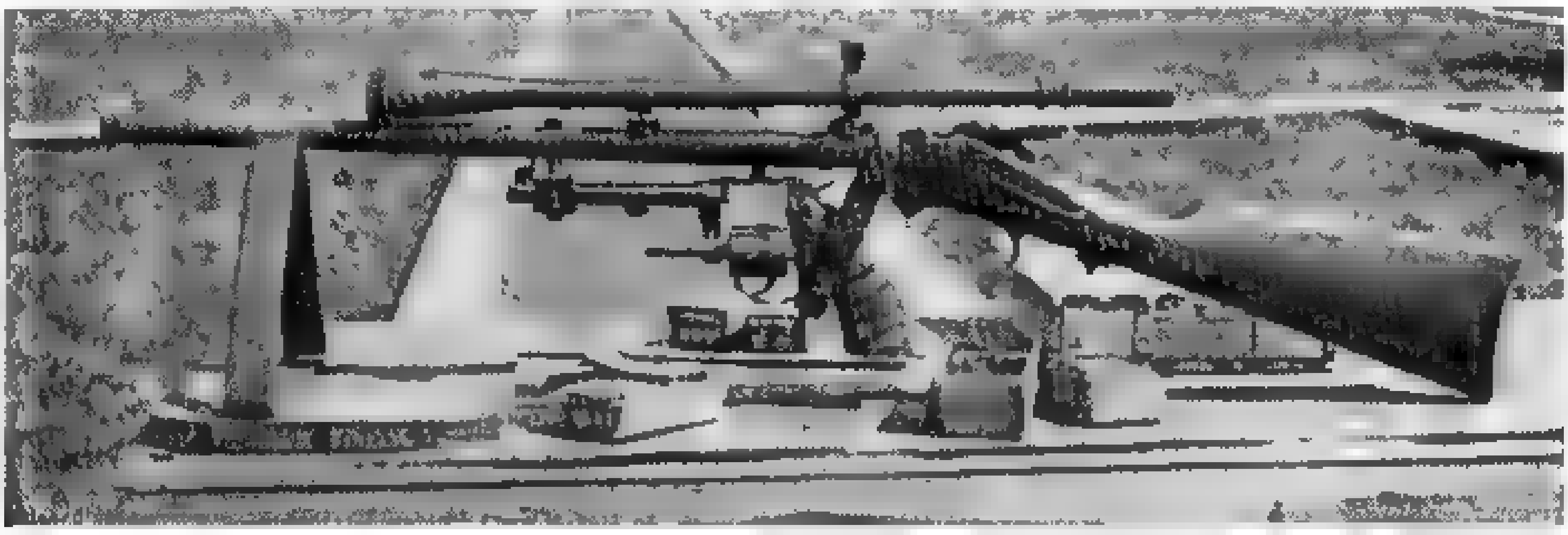
If the shooter owns his own land and expects to occupy it for a number of years, the best method of anchoring these legs into the ground is to dig holes varying in size from 18 inches to 2 feet and at least a foot deeper than the depth the legs are to be buried. Sturdy rocks are dropped into the bottom of the hole to form a solid bed. The legs are then dropped into position on top of these rocks, and concrete is poured in to fill the hole, with occasional large rocks tossed in to blend with the concrete and further anchor it. It is possible,

of course, to use forms around the legs and thus economize on concrete. The bench, however, will be sturdier if the mixture is poured in until it fills the hole and all the tiny irregularities in the walls of the hole, thus anchoring it more solidly than through the use of forms themselves. Be certain that your concrete bed goes below the frost line to prevent winter damage.

The legs, of course, should be properly lined up in the direction of the target before the concrete is poured or the earth shoveled back. Then, when your mixture has thoroughly settled or your concrete is thoroughly hardened—in about a week—you are ready to build your bench. If you set the legs in concrete, you will be unable to remove them without digging up half the community, which means that they must be squared up through the use of level, plumb line, etc., *before* the concrete is poured. You cannot alter them later. The same also goes for the lining up of your bench legs, if it is desired to use only dirt to fill the holes. It will be found that short sections of boards lightly nailed to the legs will aid greatly in trueing them up. These boards can be torn off before the top is built and after the framework serves its purpose. Do not cut off the top of the legs or posts until the entire job of bedding the legs is completed. Let them stick up in an irregular fashion until you are ready to build your top. They can then be squared up so that the bench is level.

The height of the shooting bench depends entirely upon the individual shooter's preference and his physical characteristics. It should be constructed with an arm on the right-hand side projecting out beyond the right rear leg of the bench from 18 to 24 inches. This, of course, will be suitably placed during construction and permit the shooter to move up to the bench so that his stomach rests against the rear edge and his side against the projecting arm, whereupon the arm serves as an admirable elbow rest for the right elbow. For left-handed shooters, of course, this arm should be on the left-hand side, and many gun bugs construct an arm on either side to permit either right or left shoulder testing.

The top should be built of not less than 2-inch planks. The sturdier its construction, the more durable it will be; and oak is by far the best material for this purpose. It should be braced as much as possible and should have not more than a 2-inch overhang; but this overhang is important.



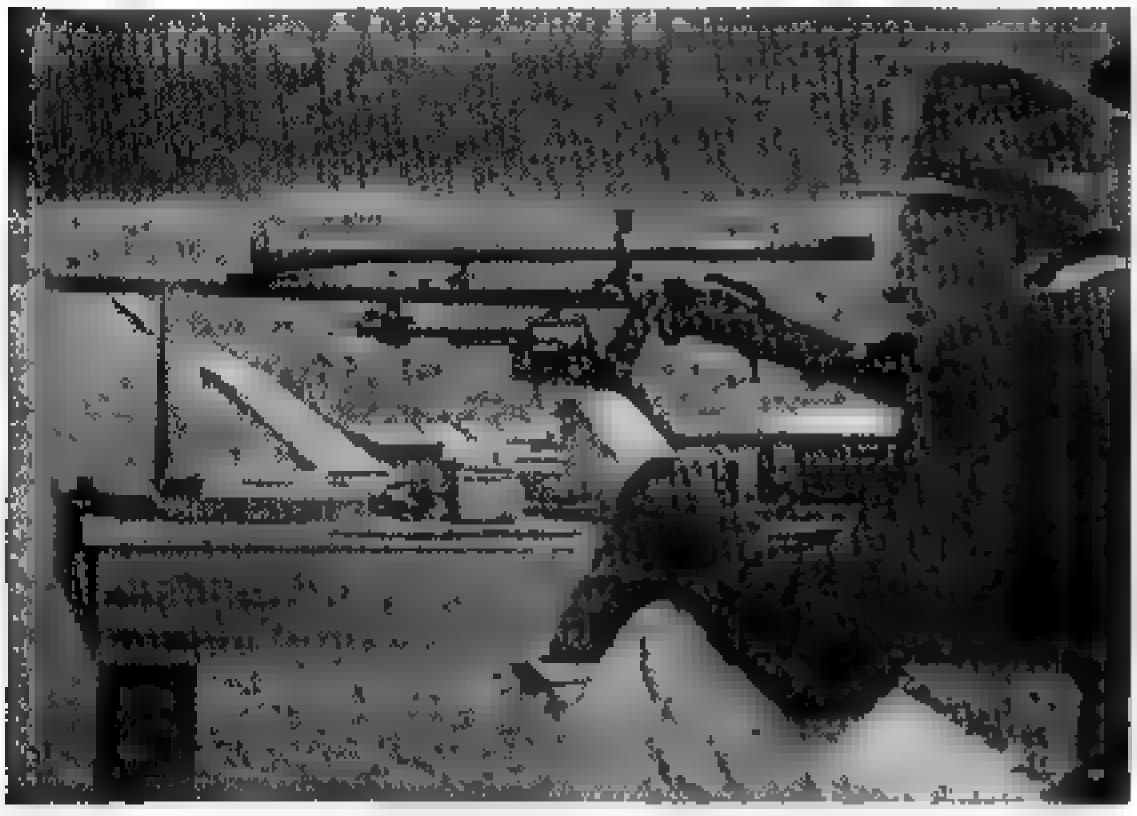
With an old discarded rifle, one can make a useful machine rest for testing revolver ammunition. This one is designed by Rance Triggs, of Chatham, New Jersey. The revolver is clamped beneath the old rifle barrel and a telescope sight permits of long-range sighting

Many handloaders, for instance, on a comfortable summer's day will decide that they want not only to shoot from the bench but to conduct loading operations in the field in an effort to determine a particular load desired. A sturdily constructed shooting bench with proper overhang will permit of the attachment of powder measure, balance, loading tool, and any other equipment you may happen to bring along; and if it is built large enough, these instruments can be left in position until you are through shooting.

Wherever possible, nails should be eliminated from the construction of a shooting bench. Bore proper holes and use large and sturdy bolts or lag screws, backing up the lag screws, of course, with large iron washers. If it is desired to present a smooth surface—and this is more or less essential—a counterbore can be made in sufficient size by use of an extension bit, so that the washer and lag screw head or bolt will be flush with the surface. After a damp spell, the bench should be tightened up for the next few weeks until it is certain that it is properly staunch; whereupon those counterbores can be filled with putty and the entire surface of the bench painted.

Painting a shooting bench is far more important

than many gun bugs realize. Paint has long been a wood preservative. The painting should be done so that all parts of the wood are completely covered and all leg joints are sealed to prevent the entrance of moisture which might cause warpage.

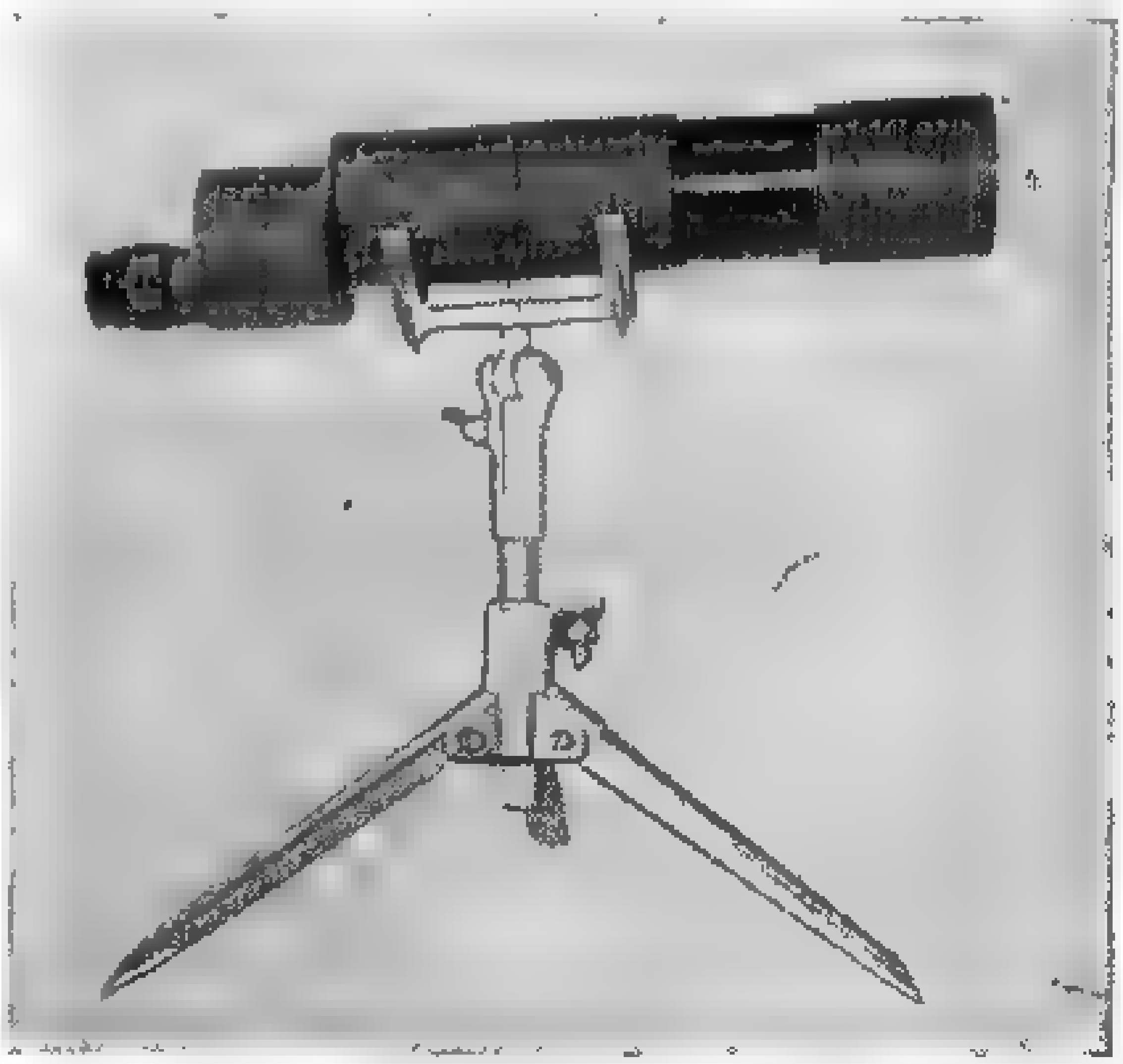


The boys around Chatham, New Jersey, use an improvised rest for testing revolver ammunition. An old rifle serves this purpose extremely well, and since group rather than point of impact is important, one can use a telescope on the rifle without adjusting for zero of the revolver. The above photo shows Norman Jost using this device

This means that the under side of the bench is to be painted as well as the exposed surfaces. Any color will do, although green is a popular shade for the chap who likes style. Many gun bugs see that the top of the bench is properly leveled and smoothed up, whereupon they coat it thickly with paint and lay on a sheet of light duck, tacking the edges tightly. At the same time, they slap a coat of paint over the duck, which not only thoroughly waterproofs it but gives an excellent appearance to the bench top. It takes some time for this material to dry, however, and it should be protected from rain during the drying process. Once it has dried out, the duck will be thoroughly cemented to the wood bench by the under coat of paint, and will be clean and watertight.

The author does not intend to specify a particular type of shooting bench. He has seen several dozens of these used by various shooters, and practically every one was different from all the rest. The idea of all of them, however, is essentially the same, and the handloading fan should first sketch out his bench on paper and then consult some of his friends for additional suggestions. There is just one thing to remember: you can put all the bracing you desire around the sides and front, but the rear must be kept completely open, so that during the shooting process the chap using it may sit close and still have plenty of room for his knees and legs. Any type of seat may be built to go with it, but a backless stool is usually quite satisfactory. An ordinary kitchen stool serves well for this purpose if the ground is hard packed. It should not be wobbly and should be of a proper height to fit the man using the bench. By all means, construct your shooting bench *first*. The building of something to sit on depends entirely upon the construction of the shooting bench itself, and is really, one might say, a more or less unimportant detail. Not long ago the author visited a friend who has a private test range and a shooting bench beautifully constructed and painted, which must have cost him more than $50. It had all the features one could possibly wish for, and at the same time the only thing available for the shooter to sit on was an empty .30/06 ammunition case, stood on end. It happened, however, to meet all the requirements of this particular handloading fan—and that was enough.

Using a Shooting Bench. After the shooting bench is completed, it is ready for use. Some chaps like to lie down and do their test shooting from a prone position, hooked up in a sling. A shooting



For test work a spotting scope is highly desirable. The Bausch & Lomb prismatic model cannot be beaten for this purpose

bench, however, provides the necessary artificial aid to eliminate completely the human error of *holding*. It cannot, of course, eliminate the sighting error, which is something else again. With a suitable bench rest it is possible, up to 200 yards,

to equal machine-rest firings with any given rifle. I say this without reserve. If a chap knows his gun, knows his sights, and knows how to use his bench rest, he can shoot smaller groups than is possible in a machine rest. The average machine

For 200-yard test work with a revolver, the author made special bases for a Weaver 3-30 telescope sight. The gun is held in two hands and shot from a bench with the eye in proper relation to the telescope

rest, contrary to the greatly misunderstood idea of these mechanical devices, is by no means fool-proof and depends on the skill of the operator to a considerable extent.

There are two methods of testing for accuracy with a shooting bench. One is the muzzle and elbow rest, the other the forearm rest. Still another method, suitable only for rifles of very minute recoil, is the straight forearm rest in which the gun, while balanced on a sandbag, is touched off with pressure between the forefinger and thumb, the latter steadied against the trigger guard and the rifle not touching the shoulder of the shooter. This little trick can be acquired only through experience, and is suitable for light squib loads in heavy bull guns or for any of the standard loads for low recoil guns such as the .22 Hornet.

The muzzle rest is widely used by many shooters, but this is one method which the author has never cared to recommend. Through the use of a muzzle rest (resting the muzzle on some object) there is a great possibility of scattering shots to the four winds because of the vibrations of the barrel. At the same time, if too much downward pressure is made against the muzzle rest and this pressure is varied between shots, there will be a very noticeable stringing with certain types of guns and cartridges.

The Sandbag Rest. There is no such thing as a conventional "forearm rest." My good friend H. Guy Loverin, of Lancaster, Massachusetts, who in recent years has done much of my bullet casting, rests the forearm across either a sandbag or a padded wooden block. The sandbag is most convenient and should be made of one or two ten-pound sugar bags filled with a good clean sifted and comparatively dust-free sand properly sewn up. It should not be completely filled, but should have sufficient flexibility to permit the shooter to reshape it to fit the forearm of the gun—or his own forearm and wrist, if he desires to rest them. If two sandbags are used, different heights can readily be obtained. This is far more convenient than using a single large bag. One sandbag may be stacked on top of the other very conveniently and moved forward or backward until the proper position is obtained. They will remain in that position more or less of their own inertia.

Shooting of this type is actually one-hand shooting with a rifle. The forearm is bedded into the sandbag to steady it, the initial work of course being done by hammering the sandbag gently with the doubled fist to form a proper groove. The butt of the rifle is braced against the shoulder with

A good shooting bench is desirable for any form of test shooting. The above bench is made from 6 x 6-inch posts and set five feet into the ground, and not even a heavy Maine frost will throw it out of alignment. No nails are used in this bench—nothing but bolts and lagscrews

the elbow lying almost flat on the extension arm. The left elbow is then laid equally flat on the table body, and the shooter hunches down until he is in a comfortable and steady position. A telescope sight is very useful for this test work, and if the

shooter is in proper position there will be no wavering of the target thus necessitating "holding."

Another method of using the sandbag rest is to grasp the rifle in normal shooting position, the left hand grasping the forearm. The hand is then pushed into the sandbag to bed and support the wrist in proper position. In this case the hand practically rests on the rear curve of the sandbag while the forearm of the gun does not touch it in any way. Still another method of accuracy testing is either with or without the sling, sitting at the bench, the right elbow resting on the extension of the bench top and the left on the top of the bench. In every case the shooter should hunch up to steady his own body against the bench itself, and should be sufficiently free to move around for the necessary reloading and yet return quickly and surely to the same firing position.

H. Guy Loverin, of Lancaster, Massachusetts, noted commercial bullet-casting specialist, does his test work from a shooting bench

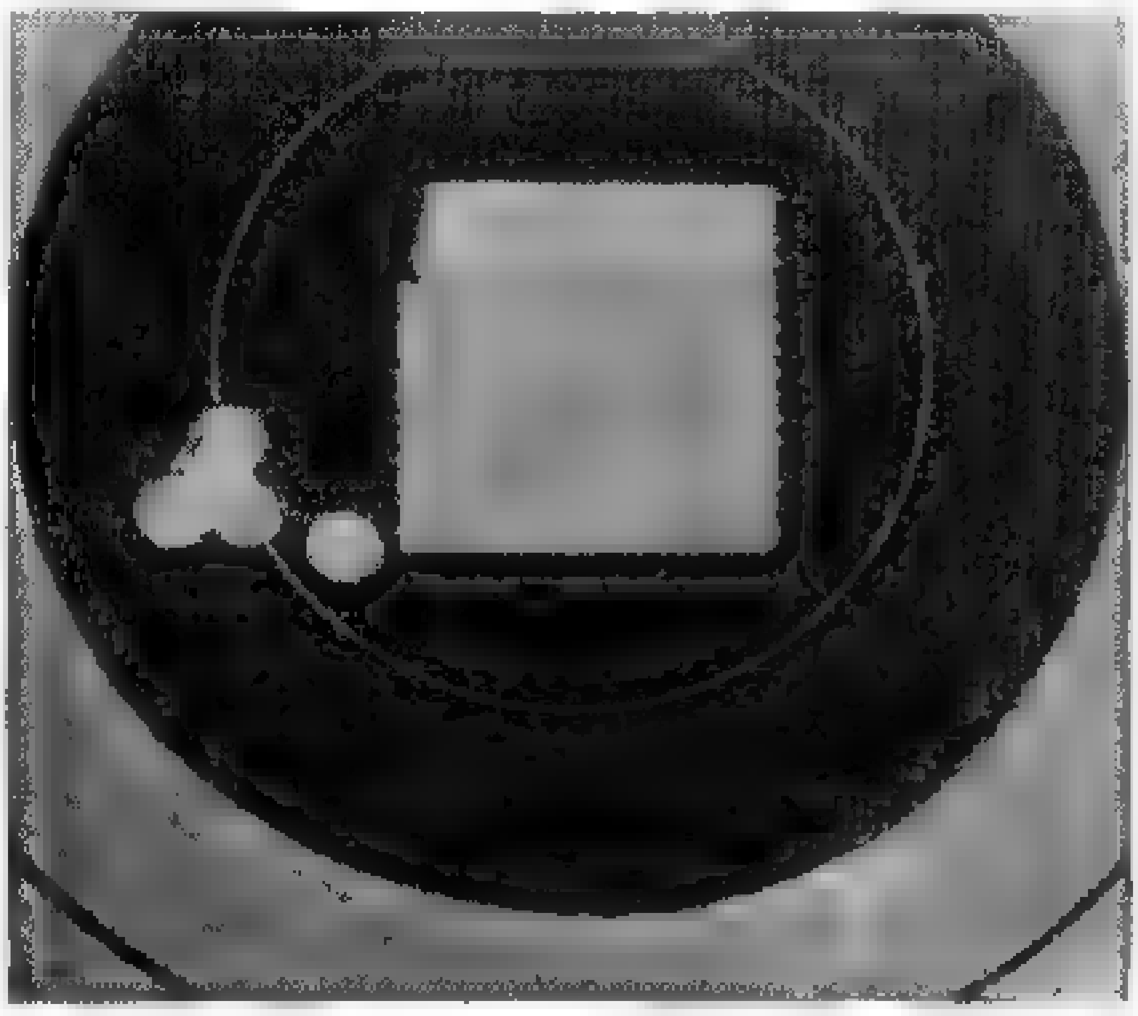
Accuracy tests of ammunition should be conducted systematically if anything is to be learned from their performance. Your group firing can be at any desired range and may be either five- or ten-shot groups. It should, however, be extremely uniform in firing speed. If, for instance, you are shooting a high-velocity load of ten shots, do not attempt to rapid-fire your string, despite the fact that with the artificial rests available this might be comparatively easy. Start your string as they would do it in a laboratory—by fouling your barrel with a couple of junk loads, odds and ends—using a bullet and powder similar to the load which you have. If you desire to fire a ten-shot group, the most practical method would be to start with a clean barrel and fire two shots of the same load but not for record. You can throw these down in one corner of the target or into your backstop without attempting to shoot for group itself. Then, with barrel properly fouled, you are ready to start in your test string. Fire with reasonable speed, approximately one minute between shots. If you have a spotting scope handy—and this is the most useful accessory to any rifleman who desires to test for accuracy—the interval of time between shots can be readily consumed by tilting the head to one side and spotting the shot through the telescope, then returning to the shooting of the arm.

Never run your cartridge into the chamber of a warm barrel and let it stay there. Insert it only when you are ready to shoot, and then shoot as promptly as you can, consistently with perfection of aim. If you are shooting for group, do not bother with the location on the target, and do not change your sights until the string is finished. Group and scores are different things, and you can learn much without adjustment of sights. One load, for instance, at 100 yards in a particular rifle will group exactly where sighted. Another load using a different bullet, different velocity, or even the same velocity with a different bullet and different powder, might easily group high, low, left or right. Always keep a record of the results of these tests. Otherwise, they will be in vain.

Hornet bullets may be tested for expansion by shooting into ordinary turf near small stakes pushed into the ground at ranges of from 100 to 200 yards. The above bullets were recovered at 100 yards and clearly show that hollow points do not expand. Note construction of bullet where core flows forward within the jacket. The upset bullets were recovered specimens of the soft-point variety. Note the difference

Machine Rest. A machine rest is very desirable, but unfortunately it is rather expensive, difficult to obtain, and more difficult to operate. For the

handloader, the most practical machine rest consistent with the average pocketbook is the Weaver, which sells for about $10. This rest is a modification of the "V" type mount and consists of two heavy steel "V" blocks mounted on a one-inch steel plate which in turn is bolted to the shooting

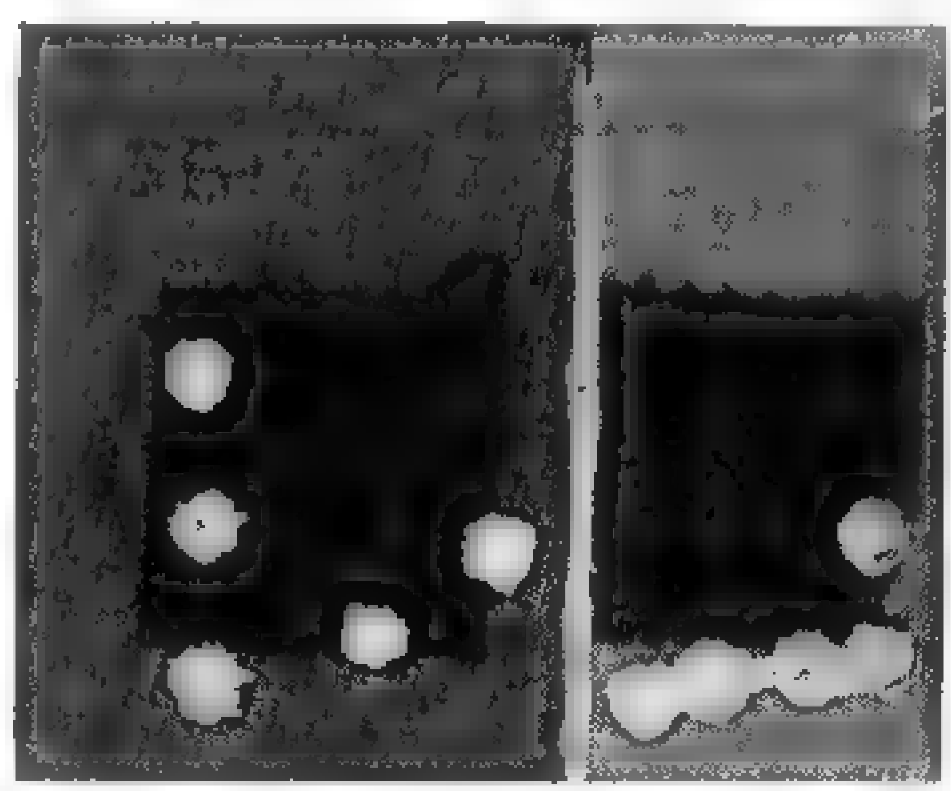


A white paster, either square or round, stuck in the center of a black bullseye makes an excellent aiming point if a telescope sight is used for testing. The above group was shot by Captain G. L. Wotkyns with his original version of the .220 Swift; range 100 yards, size of paster approximately one inch square

bench. The "V's" may be varied in distance from each other by means of different holes drilled in the base proper. In use, a special clamp which comes with the rest is put around the barrel of the gun just in front of the forearm and clamped by means of wing nuts. On this clamp is a prong which fits in a slot to zero the rotation of the gun around the axis of the barrel. The "V" blocks at front and rear, into which the rifle is laid, control the centering of the gun on the target. The weapon is merely laid in these "V's" with the barrel guide pushed into its proper "V" slot, which lines the gun up with a certain predetermined aiming point. The recoil, of course, is more or less free, as the gun is permitted to slide backward normally. For each shot it is pushed forward again until this barrel clamp guide registers. In operation it is quite simple, but the best results are obtained by an operator after practice. This particular outfit can be used with excellent success on rifles having a recoil as great as the Springfield. It does eliminate the sighting error to a marked degree, but the zeroing of the gun to locate the impact on the target is more complicated than the forearm- and elbow-rest type of shooting. This rest is manufactured by W. R. Weaver of El Paso, Texas.

The chap who desires to use his bench rest for the testing of handguns will find that the sandbag stunt is of extreme value. For this work the shooter sits up to the bench, takes his weapon in both hands, and rests the hands on or against the sandbag. Sighting, of course, is done in the normal way, and the arm must be extended to its full length or the sights will be more or less blurred, making it impossible to do good shooting.

Another method of testing handgun stuff is by means of a special machine rest of the type recently designed and built by Rance Triggs, of the Madison, New Jersey, Rifle and Pistol Club. This stunt has been worked out a number of times in years past, and consists of using an old solid-frame rifle of Sharps, Ballard or what have you which is so completely rusted or ruined that it is no longer fit for service. A muzzle clamp is bolted through the barrel at the midway point where the forearm is removed. A special clamp, hinged to the rear of the barrel by means of a bolt running through it, goes down to the frame of the revolver and buttons around the forward part of the grip. This must be designed properly by the gun bug to fit his particular guns or the clamp will scratch and otherwise mutilate the barrel during the firing operation. The rest, however, can be built with equipment which any gun bug can dig up in his junk bin and is therefore not expensive. It requires a shooting bench and some form of a muz-



Black pasters on a gray or white background serve excellently as aiming points for telescope sight testing

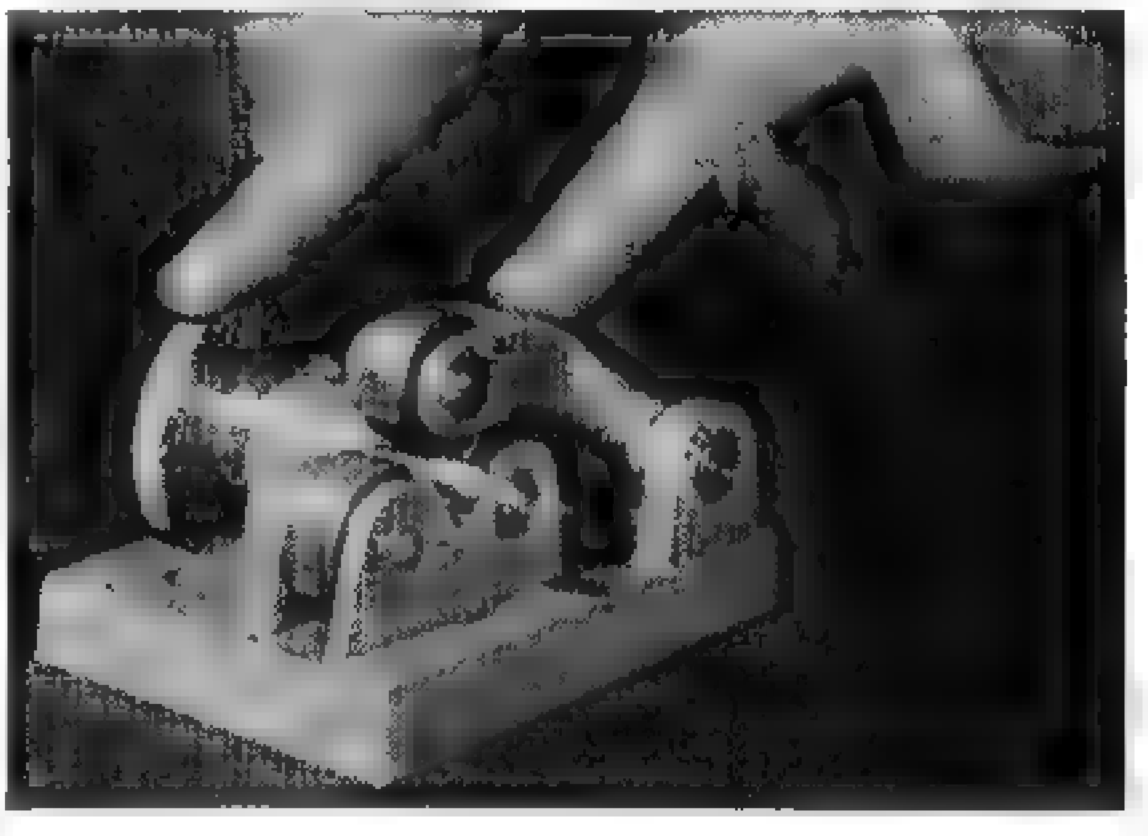
zle support to hold the barrel, although the butt of the rifle is either rested on the bench or held against the shoulder. If a muzzle support is of the movable variety, the shooter can fire on several targets at will, and thereby test his handgun ammunition at short and long ranges.

If telescope sight blocks are mounted on the barrel of this gun, the shooter can utilize his ordinary target rifle scopes to very good advantage. The gun is buttoned into position and a few shots fired to zero the point of impact with the scope. From that time on, the trigger is released by means of pressure between the thumb and forefinger against the trigger and back of the trigger guard, using the gun, of course, single-action. Aiming is done by means of the telescope sight. It is possible to test handgun cartridges at 200 yards and farther with a device of this sort, and it is surprising to learn that in a good target revolver, Match grades of ammunition such as the .38 Special are capable of shooting into groups as small as four inches at 200 yards when fired from a six-inch barrel.

The Triggs machine rest was built entirely by Mr. Triggs, who appears to be a skilled amateur gunmaker as well as an expert pistol shot. He used an old Sharps carbine of Civil War vintage, supporting the muzzle on a flat steel triangle to prevent canting. This triangle rests on a soft rubber pad fitted to the firing table. His equipment is now in use at the Madison, New Jersey, Rifle and Pistol Club Range by various members of the club for the sole purpose of testing out their handguns and assorted loads of handloaded and factory loaded ammunition. With this rest it is possible to shoot a revolver with the consistent precision of a rifle. When used with the telescope sight, it also permits of a very fine aiming point which could not be seen with the naked eye from the firing line.

Targets. What to use for targets? This question frequently arises in the minds of those who wish to test for accuracy. If a telescope sight is used, any form of bullseye is satisfactory, but the type of reticule must be taken into consideration. If cross-hairs are used, the smallest possible bullseye will give best results. Using an 8 × scope with .0005 or .001 cross-hairs at 100 yards, the author likes to use a standard small-bore target with an ordinary one-inch round white target paster in its center. Aiming is not at the bullseye but at the target paster in its center, and this white against the black is quite visible through the telescope and can be quartered with the cross-hairs to greatly eliminate error of aim.

When open or peep sights are used, a bullseye is not as satisfactory for group shooting as the inverted "T"-type target. This target consists of a black horizontal line from the center of which runs a black vertical. The size depends entirely upon the range at which it is to be used. For 200 yards these black bands should be from 2½ to 3 inches wide. For 50 yards not over one inch wide. Experimenting will show the handloader which is the most satisfactory for his particular type of sights and his individual eyesight.



Wesnitzer bullet spinner. This spinner may be used to test bullets or loaded cartridges for concentricity. The cartridge is placed in the position shown, and the large wheel rotated with the finger. If the bullet is seated perfectly true and is in itself concentric with its own axis, neither the cartridge case nor the bullet point will wobble. If it wobbles badly, reject it for precision shooting. Lower: The spinner used to check bullets. If an overhead light is concentrated on the bullet, the wobble can be more readily detected by observing the shadow of the bullet

There are two methods of manufacturing these inverted "T" targets—they cannot be bought. The first is to paint them on ordinary heavy paper or cardboard; the second is to cut them out of black paper and paste them on white or ivory. The latter method is excellent if the gun bug happens to have plenty of black paper. If he lives in a city or near a photographic gallery the photographer will be glad to give him all the black paper he

cares to carry away. For this purpose the ordinary red paper wrapped around roll films is exceedingly useful. This paper is surfaced with a dull black on its back or inside. It is thrown away by photographers, and a single trip to a studio where amateur developing and printing is done will net the gun bug a supply which will last him for many months. It should be cut in strips of suitable width. There is, of course, no necessity for making your target too large. Only experimentation will show you the proper size, as eyesights and gun sights differ tremendously. A smaller "T"-type target can be used at long range if the handloader tests with a telescope sight having a thin taper or flat top post. The bands, whether used for open or iron sights, should never be wider than absolutely necessary to give a distinct vision of the "T" when sighting it in. At the same time they should not be too small. Aiming point, of course, is at the junction between the horizontal and vertical black lines. A six-o'clock hold should be taken with the front sight just touching the black of the "T."

A homemade bullet spinner designed for checking concentricity of loaded cartridges. The device is clamped in a vise of some sort and the cartridge case laid into the proper groove. The neck operates in a V groove. The cartridge case is spun by pulling back and forth on the string wrapped around it. Wobble of the bullet is noted during the inspection

Game Bullet Tests. Another test which will appeal to every handloading fan is one to determine the mushrooming qualities and shocking power of various game bullets. This problem is far more complicated than that of accuracy. It necessitates particular tests for each type of bullet. There are a great many factors controlling the expansion of various game bullets, and wherever possible an attempt should be made to simulate actual conditions. There has never been a positive substitute for game. If you want to know how a certain bullet will perform at 200 yards on woodchucks, the only way to determine this is to shoot it at 200 yards—against woodchucks. Extreme care in shooting must be undertaken.

A particular friend of ours had a brilliant inspiration some ten years ago, and we conducted tests under his idea until we learned that in theory it was wrong. Bullet performance, of course, depends to a certain extent upon the velocity. An expanding bullet will perform differently at 200 yards and at 500 yards if driven at the same muzzle velocity in the same gun. This chap wanted to know what the performance of bullets would be at 200 yards, so we set to work to determine the remaining velocity at that range with the particular bullet in question and the load which we desired to test. Starting at a muzzle velocity of 2600 in a twelve-inch twist, we found that that particular bullet should have a remaining velocity calculated by means of accepted ballistic tables of 1663 f.s. Accordingly, we went to work on that basis and loaded to a muzzle velocity of about 1660, thus hoping to obtain the desired ballistics equal to 200-yard shooting. We found, however, that expansion was nil and the results most unsatisfactory. Then we determined to learn the reason for this.

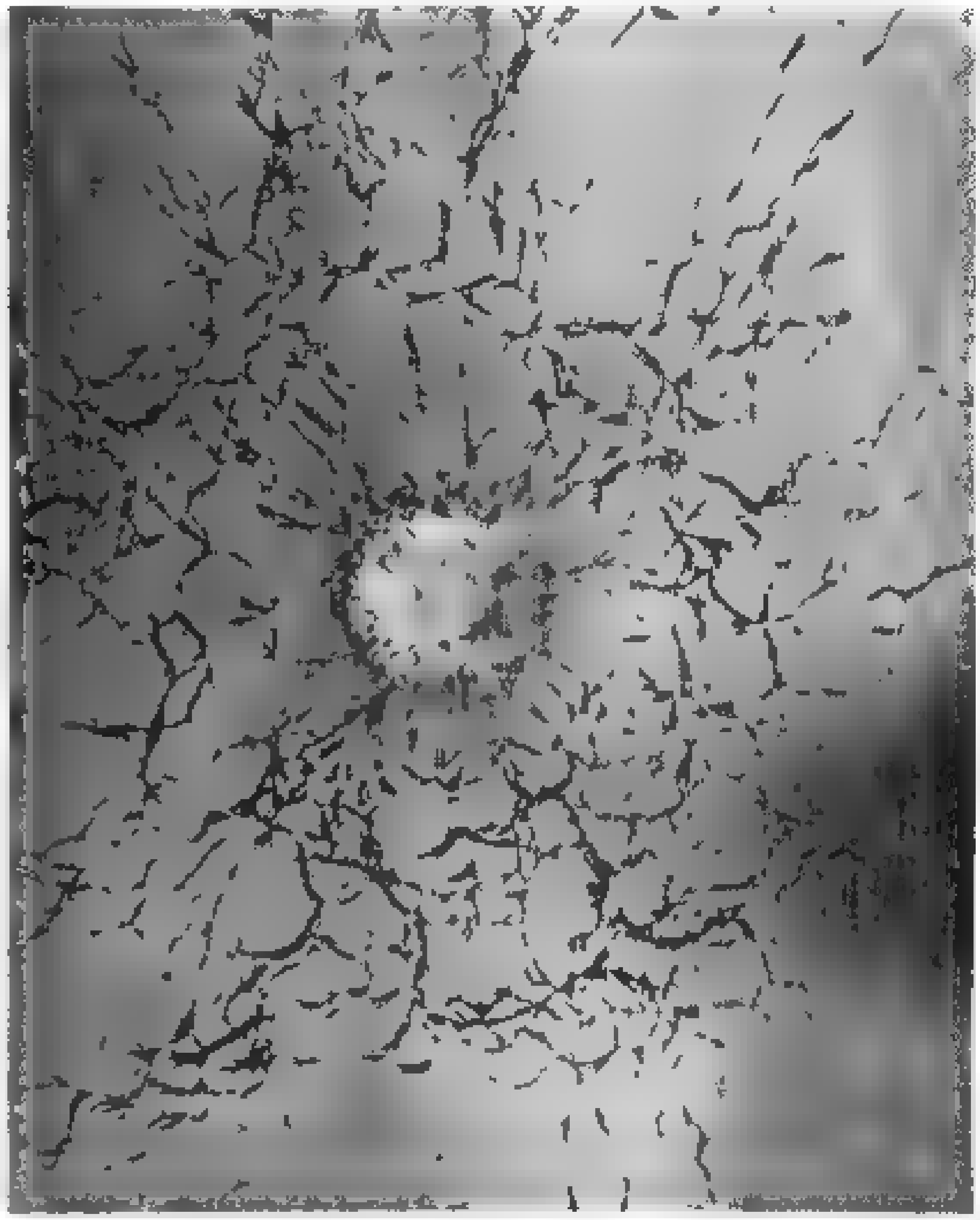
The true gun bug is never stumped. Sooner or later he learns the answer, and in this case we did it with reasonable accuracy in a short time. The gun in question had a twelve inch twist. At a muzzle velocity of 2600 f.s., therefore, the bullet had a rotational speed imparted by the twist of 2600 revolutions per second. When we loaded down to 1663 muzzle, the rotational twist was only 1663 revolutions per second. I do not have the calculations at hand indicating the approximate *rotational* speed remaining at 200 yards when started at a muzzle velocity of 2600, but the loss is

comparatively negligible. It is well to bear this in mind. If you desire to test for penetration, mushrooming qualities, etc., at 200 yards, you cannot simulate remaining velocity by loading to a low muzzle velocity, unless you use a special barrel which will develop the necessary rotational spin. This, of course, is out of the question.

Mushrooming tests can be conducted in various materials. Some factories use soft pine boards, plane both sides, and thus reduce them to a thickness of ⅞ inch. These are invariably mounted in little sliding racks so that they may be easily removed, the boards being spaced one inch apart. It is well to point out here and now that if you desire to conduct any experiments with boards you are going to run into an expensive proposition, particularly if you use a high-power rifle. The boards must be at least 10 inches square or the bullet will split the remaining boards and pass out, thus wasting a great amount of wood and giving no information whatever. Also, your wood must be hand-selected for uniformity of grain. It must be first quality stock, free from knots, sap, pitch, and other variables. Such wood is extremely expensive, and the cutting of it necessitates the waste of a great deal of additional stock, which, while suitable for building purposes, cannot be used in your penetration tests. Some people use cypress, some spruce, oak or any other hard or soft wood.

It is well to point out here and now that mushrooming tests made in boards have no value whatever to the handloader. They will show you just what that particular bullet at that particular velocity will do in that particular type of wood. A single shot is useless. At least ten shots must be fired to verify the findings with that individual load, and you will create an awful lot of extremely mutilated kindling wood suitable for no other purpose.

A few years ago the author was requested to make a series of tests using a particular expanding bullet manufactured out of the country but suitable for the .30/06 rifle. In firing twenty-five shots for test, approximately $25 worth of Grade A pine boards was consumed and we learned very little of the performance of the bullet in question, particularly in regard to game. Handgun and rifle bullets can often be tested for "wounding" power by shooting into cakes of soap or blocks of paraffin. This, however, despite recommendations of many writers, is by no means as practical as it would seem. Soap is soap, not flesh, and no two batches of the same brand of soap are likely to give identical results with a given load. Not long ago I was conducting a series of tests with a .22 Long Rifle Hollow Point. I purchased two dozen bars of a certain brand of laundry soap and got some excellent funnel-shaped holes that were extremely uniform. When all the soap cakes were consumed, we went to another store and bought an additional half-dozen of the same brand. Using cartridges from the same box, we found that instead of having the funnel-shaped holes, the cakes were



Shatter-proof windshield glass is excellent for comparing shocking power of different bullets. Windshield glass and windshield wings in sections large enough for test purposes can easily be obtained from auto dealers for the asking. The above section was shot with a .220 Swift soft-point bullet at a muzzle velocity of 4200 f.s.

completely shattered, looking more like victims of a high-power rifle than of a .22 Hollow Point. There was absolutely no comparison.

What was the answer? Simply that the two batches of soap were from different lots. The completely shattered cakes had been on the shelves for a long time, and had dried out and become brittle. Accordingly, the bullets shattered them on impact, whereas the softer ones merely funneled out as the bullets expanded. This test has been verified on at least half a dozen other cakes, and the author, when using soap for tests, verifies his firings with a particular standardized load. Instead of buying in large quantities and keeping the soap on hand, he buys merely that which is desired

at the time and shoots at least two shots with a previously tested load, noting the effect. This is compared with a "standard record" in which two cakes of soap were photographed front and rear to show the effect of the particular test bullet. Information thus obtained after firing the new load and compared with the old will give a rough idea of what the bullet will do—*against soap*.

One of the most practical tests is against modeling clay. This is more inclined to be uniform than anything which the author has tested to date. Standard modeling clay, either gray or green, and having an *oil base*, is purchased in the regular pound bars. It is somewhat expensive but can be used over and over again. The last batch we purchased cost 25 or 30 cents a pound, and we ordinarily buy it in ten-pound lots. This clay is very dense and will not harden. The type which is mixed by the artist and which sets into a solid mass is of no value whatever. In using modeling clay it should be pressed by hand into a loaf of sorts. Packing it into an ordinary tin bread pan, such as is obtainable in hardware or 5-and-10-cent stores, is an ideal method of making these blocks. It can be hammered slightly to cause air pockets to fold out.

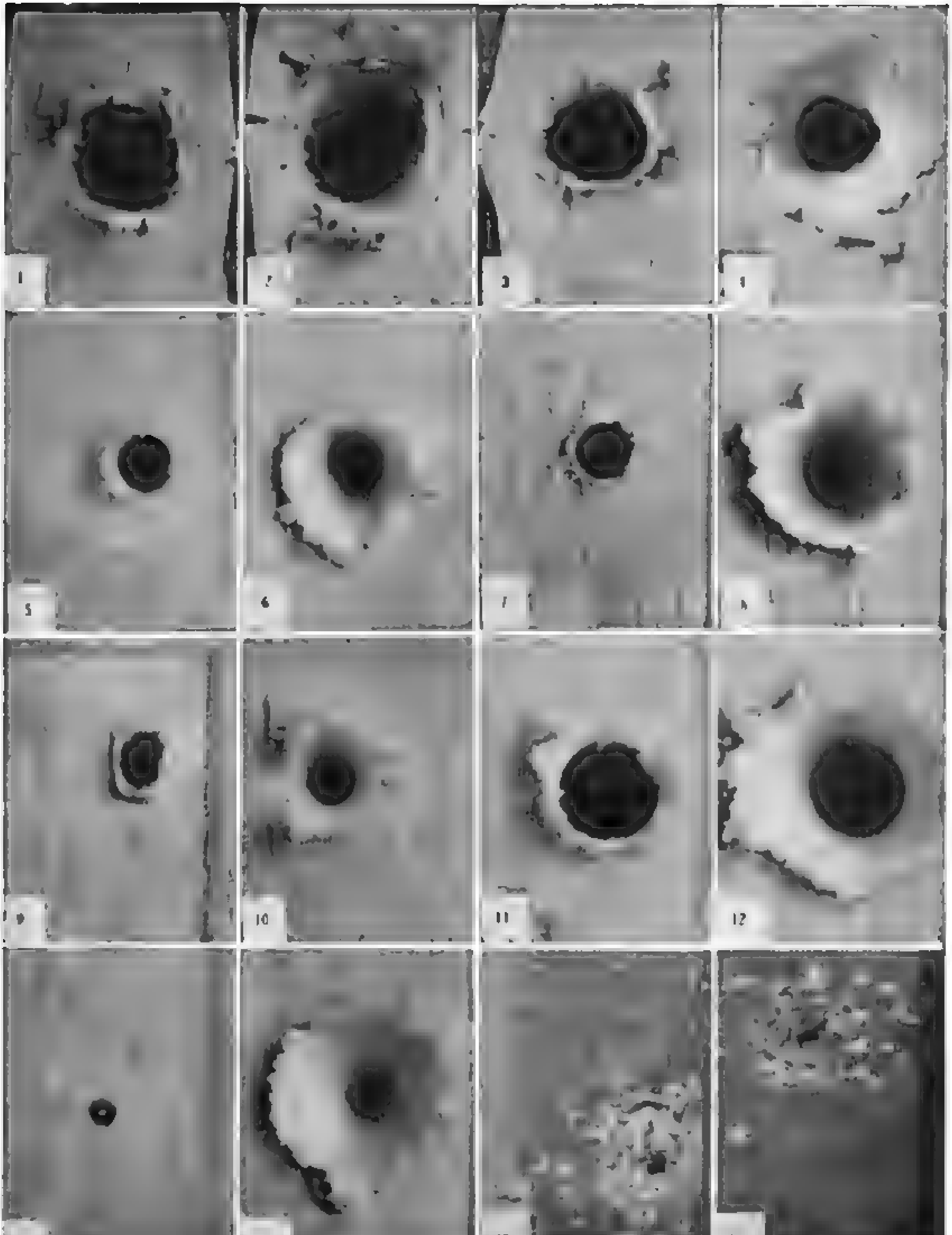
Shooting into this clay with a high-power rifle, however, is inclined to blow an excessively large crater with a loss of much material. The writer handles this most effectively by placing a large block of clay, approximately 6 x 6 x 6, on a light wood pedestal balanced inside of a corrugated board, paper or fiber carton. A carton of this type is inexpensive and can be obtained usually for the asking from any business house. The blocks should be placed well inside the mouth of the box, which is stood open end toward the shooter. A suitable backstop must be provided for the bullet, of course, which is rarely, if ever, recovered. The back of the block of clay should not be closer than eight or ten inches from the bottom of the box. In firing, the bullet is aimed at the center of the mass and will blow a large crater through it. The characteristics of this crater can be measured by the shooter and entered in his notebook, whereupon the various gobs of clay are scraped from the sides and bottom of the box and the mass remoulded by packing it back into the little bread tin.

An unusually uniform material for testing bullet expansion is that of ordinary pulp-paper magazines. The shooter who lives near a large city can easily arrange with the magazine distributor (not the retail dealer) to let him have all the magazines he wants, either for the asking or for the scrap-paper value, which is usually merely a few cents per hundred pounds. Pulp-paper magazines are invariably sold to dealers on a basis of being "returnable." This means that the dealer may return any unsold copies when the next issue comes out and receive full credit. The unsold magazines returned to the distributing houses create a problem of disposal. Extreme care is being taken to prevent their leaking into second-hand magazine establishments which bootleg them at two or three cents a copy in retail sales. These magazines, therefore, are carefully destroyed.

At the distributing house the covers are stripped from them, and these the distributor returns to the publisher that he in turn may get his credit for unsold copies. The remaining material is junked, and to prevent its being used for re-sale purposes, it is either run through a cutting machine or the individual magazines are torn through the center to destroy their usefulness, whereupon they are bundled up and sold as scrap to junk dealers. A gun bug, if he has a reasonable standing in the community, can readily convince the manager of the distributing house that any magazines passing into his possession will not be used for re-sale purposes, and can therefore obtain them before they are either cut or torn. The cutting and tearing destroys their usefulness completely.

ON THE OPPOSITE PAGE

A few experimental firings with various bullets into identical cakes of soap on the same day with the same lot of soap. Variations in different batches of soap will give similarly varying results. Numbers 1 and 2: The .357 "Magnum"; entrance diameter 1.38, exit diameter 1.58 inches. Notice breaking effect on soap cake. Numbers 3 and 4: The .44 Sharpe Hollow-Point "Magnum" at a velocity of 1200 f.s. with a 242-grain bullet. This is the most powerful "big bore" load ever attempted. Note comparison with the standard .357. Entrance diameter 1 13/16, exit diameter 2⅛ inches. Numbers 5 and 6: Remington .22 High-Speed Wadcutter. Entrance diameter 7/16, exit diameter ⅞ inch. Numbers 7 and 8: .38 ACP Hollow Point at 1300 advertised velocity (actually about 1200). Same measurements as .22 Wadcutter. Numbers 9 and 10: Remington .38/44 standard factory load with lead bullet. Entrance diameter 7/16, exit diameter ¾ inch. Numbers 11 and 12: U. S. Cartridge Co. .38 Mid-Range Wadcutter. An excellent killer on small game. Entrance diameter 1-3/16, exit diameter 1⅜ inch. Notice difference in tearing effect of "Magnum" bullets. Numbers 13 and 14: The much touted .22 Super-X Hollow Point in a 6-inch barrel. Entrance diameter 3/16, exit diameter 1¼ inch. Soap specifications: Fresh lot P&G white naphtha cake, width 2¾ inches, height 4¼ inches, thickness 1½ inches. Lower right: Interior of pasteboard carton used for two shots at cakes of soap placed on a pedestal five inches from the back. .357 Magnum cartridge, handloaded. Note splattering effect of small pieces of soap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The magazines will usually be delivered to him in bundles, and every effort should be made to secure one particular type of magazine. In years past the author has consumed a great many tons of *Short Stories,* merely because this magazine had a greater number of pages than the average pulp. In use, the bundles, normally tied together, are stacked on end to present a square face to the shooter. Several bundles are lined up with the

The author tries out an experimental Bausch & Lomb 80-mm. Binocular Coaching Scope. No trouble locating bullet holes with this unit

ropes still remaining in position. The shooter then steps back to his firing point, aims at a black cross crudely penciled in the center of the magazine facing him, and fires his shot, taking care that his line of sight is parallel with the line of magazines. Otherwise, the bullet will come out through the side, top or bottom of one of the bundles. Occasionally it will do this anyway. You will find that the penetration of any particular load is surprisingly uniform in this material. The best way of counting it and recording it is demonstrated in the following extract from the author's notebook:

"First 5 magazines, no expansion; hole diameter .30 cal.; started to open on 6th; diameter of exit .40 cal. No. 7, diameter of exit .50 cal. No. 8, exit ¾ inch, bad tearing of magazines. No. 9, piece of jacket caught between middle leaves; hole has very ragged edges. No. 10, complete rupture of bullet jacket apparent; tiny fragments of core scattered in leaves. No. 14, hole starts to diminish; evidence that bullet is tumbling. No. 19, hole reduced to half-inch. No. 22, remains of bullet stuck half-way through this magazine. Nos. 23 and 24, evidence of slight tearing from impact of bullet which did not penetrate through previous magazine."

The best method of artificially testing against flesh is to use these magazines *wet.* The author has tested a great many assorted bullets in wet pulp-paper magazines, and while penetration and explosive effect are much greater, the moisture content very closely approximates that contained in flesh. A thin layer of hardwood about ¼ inch thick can be inserted around the fifth magazine if it is desired to indicate a rib or similar bone. The average expanding bullet when shot into these wet magazines, tightly packed though they may be, will blow an enormous crater inside; and the same bullets, when shot in actual hunting tests upon which successful kills were made and an autopsy performed, give results indicating that this material more closely approximates the effect of bullets on tissue than any other substance.

The best way to handle your dry-test shooting against magazines is to load the car down with these bundles and set forth for your pet range. The safest place for the conducting of these tests is a convenient sand pit. A few miles from the author's home we have one of these, with the permission of its owner to use it for testing. There is, therefore, no danger of stray bullets or ricochets to worry about. After we finish our shooting—it takes a tremendous number of magazines in high-power rifle tests—an enormous bonfire is built and the material consigned to the flames then and there. Incidentally, it requires a considerable amount of time for these tests, because the mere shooting is the smallest part of the job. Shooting your holes in paper means nothing unless the information is recorded. If you use normally dry magazines, the results from day to day, week to week, and month to month will compare favorably with each other, and a complete detailed shot-by-shot record showing the effect of the expansion and the uniformity of upset should always be entered in your notes.

The wet magazine process is more effective but considerably more messy. Much of this work is conducted by the author by filling the family bathtub full of water, soaking the magazines in the tub until they are completely filled with the liquid, and then transporting them to the range in pails. The surplus water is drained off so that the magazines are just wet enough to exude a small amount

of water when compressed by the fingers. This takes very little time. Magazines, of course, when shot wet, create a disposal problem which is quite serious. They must be stacked out where they will dry thoroughly before they can be burned. This material is more useful for handgun tests where it is possible to conduct said tests in the cellar or back yard of the shooter.

Comfort on the range. A new version of recording firing data by means of a dictaphone. The author's dictating machine fitted with a six-volt motor (used with transformer on 110-volt circuit) is run with a sixty-foot cable from the auto battery. Report of each shot is made at time of firing, giving full details on light, wind, load and other pertinent facts. This system of recording is used by the author in his routine test work

The best method of lining up magazines for test work is to utilize a six-inch board ranging in length from four to ten feet. This is propped up at a suitable angle and the magazines stacked on edge thereon. This prevents the tipping sideways or the canting of the bundles, which might cause a bullet to leave the stack. High-power rifles may be tested against either wet or dry magazines to simulate effect on big game by placing a one-inch oak board in front of the first magazine to simulate a heavy bone or shoulder joint of a moose or big bear. This will start expansion and indicate whether your bullet will hold together or fly to pieces, as its path can be traced in the magazines behind the wood.

Another material widely used by some shooters for test purposes is cardboard in thin sheets. The Western Cartridge Company uses this method exclusively instead of testing in pine boards. The material, however, costs money. Beaver board is fully as effective, since that is actually nothing more than standard heavy-weight cardboard or pasteboard. Do not use wall board containing gypsum plaster. Colonel W. A. Tewes, Technical Director of the Peters Ballistic Institute, suggests the following method for the home testing of a bullet "to determine its action on smaller animals like deer":

"We instituted a test on a single cake of Fels-Naphtha laundry soap," he writes, "backed up by two bags of approximately 50 pounds of cotton waste. First firing the bullets directly into the waste and recovering them, we noted no expansion. Then firing through a cake of soap, set on end, with the flat side toward the rifle, backed by the waste at a range of 20 feet, we secured perfect expansion (using the 225-grain .30/06 belted bullet). This is a test that you can conduct yourself for your own satisfaction. It is more accurate than shooting into boards or trees, wherein the expan-

sion is more or less uncertain, due to the wedging effect of wood fiber, which has a tendency to keep the point of the bullet from expanding."

Ricochet Shots. The average gun bug who has any idea of keeping his loads within the prescribed safety limits will want to determine the mushrooming or shattering qualities of his high-speed varmint loads on "missed shots." This particular testing requires no equipment but is more or less work. The best way to do this is to make up a number of small sticks to which a small white rag is tied. You then seek out your field, select a suitable spot for the bullet to strike in the soil, sand, gravel or turf, and push the stick into the ground lightly, merely so that the white rag will be visible as an aiming point. A dozen or more spots can be chosen at the same time, whereupon the shooter paces off 100 or 150 yards for his firing. The shooting may be done from an offhand or prone position, depending entirely on what he has in mind. The loads in question are aimed at the ground in the vicinity of each little stick and two or three shots are fired, whereupon the shooter goes up, locates the bullet holes and by means of an old kitchen knife, trowel, stick or bare hands he proceeds to dig around in an effort to find the bullet. With reasonable precision he can determine whether the bullet penetrated the earth and blew up, penetrated the earth without expanding, or ricocheted. If different kinds of soil are chosen for this particular experiment, the handloader will learn much concerning the possibilities of that particular load. This test may at a later date save someone's life, or at least save the handloader a considerable amount of embarrassment. If you shoot on land that is not your own, there is nothing which will cause the owner to put the thumbs down so quickly as the whine of a ricochet. Bear this in mind. Safety is important.

A number of years ago the author conducted this particular test with all standard factory makes of Hornet cartridges. He found that more than 80% of all hollow-point loads, regardless of make or muzzle velocity, would ricochet from turf or sand from an offhand position at approximately 150 yards. At the same time tests conducted with factory loads of Remington, Winchester and Western soft points failed to show a single ricochet, and but one soft-point bullet was recovered in reasonably whole condition, the bullets shattering completely in the soil even without contacting gravel. The only hollow points which did expand at that range showed that the bullets had not only penetrated the surface soil but had run into a coarse gravel. In some cases they penetrated the soil, struck gravel, and went screaming off into the atmosphere. This information in a detailed report was submitted to all the ammunition makers, whereupon they stated that hollow-point bullets in the Hornet would not ricochet any more than any other type, and that they had never received any complaints from shooters concerning them. An article written by the author for a sporting magazine mentioned these ricochets and stated naïvely that his experience was probably unusual, whereupon a flood of letters of other shooters descended upon him verifying the ricochet experience.

The answer to this is more simple than the ammunition makers care to admit. The standard Hornet bullet, for instance, for which the makers claim a muzzle velocity of 2625 f.s., actually does not start out much faster than 2500 f.s. muzzle. This has been proved by chronograph tests conducted by the author. This same bullet, due to its light weight and poor ballistic coefficient, has a remaining velocity of from 1700 to 1800 f.s. at 150 yards, and despite its great accuracy and excellent effect upon varmints at that range, the hollow points very evidently do not expand on contact with the ground. Those which we recovered invariably showed a constriction at the base indicating that the jacket had stretched, permitting the core to flow forward. Before you take any form of varmint hunting load into the field for use against small game, test it for ricochets under varying conditions, bearing in mind that *any* bullet can be made to ricochet from water, from ice or from stones, and even from ordinary soil, if shot at the proper angle. Select the bullet which gives the finest accuracy, the most uniform expansion, and the greatest freedom from ricochets, and then be careful in your shooting.

In addition to the above-mentioned tests there are a number of others which are widely used in different places but which actually give little or no practical information. In Canada the Dominion Cartridge Company tests its various game bullets by shooting at large blocks of pure lead and noticing the different type of craters formed by different bullets. Still others shoot against mild steel plates. Your tests should be planned out to indicate their probable value for the purposes for which you have designed them. And let us repeat —there is no substitute material for living flesh! Bullets will even perform differently for different shots in the same kind of animal. You can only get a rough idea from your testing, and if the same materials are used, you can get very practical comparative information.

XXXIV

PRACTICAL HANDLOADING COMPUTATIONS WITH THE SLIDE RULE

IN 1614 John Napier of Merchiston, Scotland, first published his *Canon of Logarithms*. In presenting to the world his famous system of logarithms, Napier concisely set forth his purpose as follows: "Seeing that there is nothing that is so troublesome to mathematical practice nor doth more molest and hinder calculations than the multiplication, division, square and cube root extractions of great numbers, which besides the tedious expense of time, are for the most part subject to many slippery errors, I began, therefore, to consider in my mind by what certain and ready art I might remove those hindrances." Napier builded better than he knew. His invention of logarithms made possible the modern slide rule, and while it is a far cry from 1614 to this twentieth century of ours, his principles can well be applied by the energetic handloader to simplify certain very practical calculations. The slide rule is an accessory that is of extreme value to the intelligent handloader, particularly to that type of individual who likes to experiment.

Briefly the history of the slide rule is this. In 1620 Gunter invented the straight logarithmic scale and effected calculations by it with the aid of dividers. . . . In 1630 William Oughtred arranged two of Gunter's scales, adapting them to slide along each other and keeping them together by hand. He thus invented the first instrument that might be called a slide rule. . . . In 1675 Newton solved the cubic equation by means of three parallel logarithmic scales and made the first suggestion toward the use of an indicator. . . . In 1722 Warner used square and cube scales. . . . In 1755 Everard inverted the logarithmic scale and adapted the slide to gauging. . . . In 1815 Roget invented the log-log scale. . . . In 1859 Lieut. Amédée Mannheim of the French Artillery invented the present form of the rule that bears his name. . . . In 1881 Edwin Thacher invented the form which bears his name. . . . In 1891 William Cox patented the duplex slide rule. The sole manufacturing rights to this type of rule were then acquired by Keuffel & Esser.

Since that time there have been a great many improvements in slide rules, chiefly in adapting them to special purposes. Today slide rules are made for the exclusive use of electricians, surveyors, merchants, chemists, artillerymen (range finders), and numerous specialists in other fields.

In preparing this book on handloading the author became interested in the slide rule, as his previous experience indicated that it might prove to be an excellent time saver. In ballistics, particularly as they apply to the handloading fan, such calculations as the determination of energy, the weight of bullets when changing an alloy, and the like, entail a vast amount of figuring, particularly if they are worked out in a mathematical way. Since our experience has been confined chiefly to the use of Mannheim and Polyphase * rules, we experimented with certain problems in ballistics and found most rules to be quite inadequate for solving them. Accordingly, after making a thorough study of the various types of slide rules on the market, the Polyphase Duplex Trig * was found to be ideally suited for this work. By practicing the following individual problems on a Polyphase Duplex Trig * slide rule, the handloader will quickly determine the necessary variations to adapt them to his individual requirements.

In use, a slide rule of this nature is sufficiently accurate to properly determine the answers to these various problems. For example, if a bullet of known alloy and known weight is altered by changing the alloy, the slide rule will reveal the new weight far more accurately than it is possible for the handloader to estimate. It takes no more time to work out the problem than it does to read the following step-by-step analysis of the various problems.

PROBLEM 1

A hand-cast bullet from a .38 Special mould weighs 158 grains, when cast in bullet metal alloy composed of 20 parts lead to 1 part tin by weight.

(a) What would the bullet weigh if cast of pure lead?

(b) What would it weigh if cast of an alloy of 1 to 15?

(c) What would it weigh if cast of an alloy of 1 to 10?

* Reg. U. S. Patent Office by Keuffel & Esser Co.

SOLUTION

First find the volume of the bullet

$$V = \frac{158}{21 \times 1855} + \frac{158 \times 20}{21 \times 2880}$$

when 1855 grains = the weight of 1 cu. in. of tin in grains

2880 grains = the weight of 1 cu. in. of lead in grains

To 158 on D set 21 on C
Opposite 1855 on CI read .00406
Set indicator to 20 on C
2880 on C to indicator
and at index of C read .05225 on D
$\therefore V = .00406 + .05225 = .0563$ cu. in.

To answer problem (a): Multiply the volume by the weight per cu. in. of lead: $.0563 \times 2880$
To .0563 on C set 2880 on CI
At index read 162.1 (grains)

To answer problem (b): Use the following formula:

$$\text{Weight} = W = V \frac{b\,y\,z}{a\,y + (b-a)\,z}$$

where a = parts of metal A (lead)
b = total number of parts of metal A and metal B (tin)
y = weight per cu. in. of metal B
z = weight per cu. in. of metal A

$a = 1,\ b = 16,\ y = 1855,\ z = 2880$

$$W = \frac{0.0563 \times 16 \times 1855 \times 2880}{(1 \times 1855) + (15 \times 2880)}$$

$$= \frac{0.0563 \times 16 \times 1855 \times 2880}{45{,}055} = 106.7 \text{ grains}$$

To 0.0563 on scale D
set 45055 on scale C,
indicator to 16 on scale C,
1855 on scale CI to indicator,
at 2880 on scale C read 106.7 on scale D.

To answer problem (c):

$$W = \frac{0.0563 \times 11 \times 1855 \times 2880}{(1 \times 1855) + (10 \times 2880)} = 107.9 \text{ grains}$$

PROBLEM 2

Given a bullet weighing 146 grains in pure lead such as would be determined in the original design of a new bullet. How much would that bullet weigh in pure tin? How much would it weigh in pure antimony?

SOLUTION

Specific gravity of lead = 11.38
" " " tin = 7.35
" " " antimony = 6.76

To 146 on D set 11.38 on C
At 7.35 on C read 94.3 on D
At 6.76 on C read 86.8 on D
$\therefore$ Weight in tin = 94.3 grains
Weight in antimony = 86.7 grains

PROBLEM 3

Given a bullet of pure lead. What will be the weight of a bullet cast from the same mould with an alloy 1 part tin to 10 of lead? Also what will the bullet weight be if cast 1 part antimony to 40 of lead (factory standard alloy for most revolver bullets)? For example, a bullet weighing 146 grains if pure lead is used.

SOLUTION

The volume of this bullet is

$$V = \frac{146}{2880} = 0.0507 \text{ cu. in.}$$

From the solution of problem 1 (b) we get the formula for the weight of this bullet with an alloy 1 part tin to 10 of lead.

$$W = \frac{0.0507 \times 11 \times 2880 \times 1855}{(1 \times 2880) + (10 \times 1855)} = 139 \text{ grains}$$

The weight of this bullet, 1 part antimony and 40 parts lead, is

$$W = \frac{0.0507 \times 41 \times 2880 \times 1706}{(1 \times 2880) + (40 \times 1706)} = 143.6 \text{ grains}$$

PROBLEM 4

A bullet weighs 146 grains in an alloy of 1 part tin to 20 of lead. Should you desire to try an antimony alloy, how much will it weigh if cast 1 part tin to 30 of antimony?

SOLUTION

$$V = W \frac{ay + (b-a)\,z}{b\,y\,z}$$

$$= 146 \frac{(1 \times 2880) + (20 \times 1855)}{21 \times 2880 \times 1855}$$

$$= \frac{146 \times 39980}{21 \times 2880 \times 1855} = 0.052 \text{ cu. in.}$$

To 146 on D set 21 on C,
indicator to 39980 on C,
2880 on C to indicator,
at 1855 on CI read 0.052 on D.

Weight of bullet cast 1 part tin to 30 of antimony:

$$W = \frac{0.052 \times 31 \times 1706 \times 1855}{(1 \times 1706) + (30 \times 1855)} = 88.9 \text{ grains}$$

PROBLEM 5

The handloading fan frequently uses an alloy of lead and antimony from battery plates or from some similar source which when melted up proves to be too hard for use and its actual contents are unknown. Assume that it is definitely known that the alloy contains two metals—lead and antimony. How would you determine this alloy that you might add a proper amount of lead to soften it to the desired degree? The first step is to cast a pure lead bullet from the mould, then cast samples of your unknown alloy. Your notes will indicate something like this: Pure lead bullet—167.496 grains, unknown alloy bullet—163.439 grains. (Actual samples submitted to the author by a reader for analysis.)

SOLUTION

Weight of 1 cu. in. of lead = 2880 grains
Weight of 1 cu. in. of antimony = 1707 grains

Volume of bullet $= \frac{167.5}{2880}$

Let x = the fraction of weight of the lead in the bullet, and y = the fraction of weight of the antimony in the bullet. Then $x + y = 1$

The volume of the bullet:

$$V = \frac{167.5}{2880} = \frac{163.5\,x}{2880} + \frac{163.5\,y}{1707}$$

Multiply by $\frac{2880 \times 1707}{163.5}$ = and set $y = 1 - x$

$$\frac{167.5 \times 1707}{164.5} = 2880 - 1173\,x$$

$$1173\,x = 2880 \quad \frac{167.5 \times 1707}{164.5} = 2880 \;\text{-}1749 = 1131$$

$$x = \frac{1131}{1173} = 0.964 \text{ grains}$$

$$y = 0.036 \text{ grains}$$

If $y = 0.036$ is one part by weight

Then x is $\frac{0.964}{0.036} = 26.8$ parts. Therefore the alloy contains 1 part antimony to 26.8 parts of lead.

PROBLEM 6

Assuming that the handloading fan desires to design a new bullet and determine its weight in advance from his drawings, he will find it extremely convenient to know certain steps which will save much figuring. Assume his bullet is about .40 caliber and has a nose shaped like a cone, a true spitzer or "pencil point." First determine the volume of the cone using the following example.

Height, .456 inch, diameter at base, .3855 inch. What would this weigh in lead?

SOLUTION

Volume of cone $= r^2 \pi \frac{h}{3}$

Where r = radius of base, h = height of cone.

Volume of given cone $= (.1927)^2 \pi \frac{.456}{3} = .01773$ cu. in. There are two slide rule solutions:

(a) 1. To .1927 on D set .1927 on CI
Indicator to .456 on C
3 on C to indicator
At π on CF read .01773 on DF

2. To .1927 on D set 3 on B
Indicator to .456 on B
Index to indicator
At π on B read .01775 on A

(b) To find the weight of the above cone in lead:
In solution (1) instead of reading the volume at π read the weight 51.05 grains on DF at 2880 (the weight of lead per cu. in. in grains) on C
In solution (2) bring index of B to .01775 on A. At 2880 on B read 51 on A

PROBLEM 7

Below are formulas for figuring the volume of the frustum of a cone, extremely useful in developing the square-nose wad-cutter or "man-stopper" type of bullets. The following example is used to illustrate. Diameter at base, 1.276 inches; at top, .857 inch; altitude, 1.5 inches.

SOLUTION

Volume of a frustum of a cone =

$$\frac{\pi}{12} a \;(b^2 + c^2 + bc)$$

Where: a = altitude, b and c are the diameters of the two bases

The volume of the given frustum of a cone

$$= \frac{\pi}{12} 1.5 \left[(1.276)^2 + (.857)^2 + (1.276 \times .857)\right]$$

$(= \frac{\pi}{12} 1.5\ (1.628 + .735 + 1.093) =$

$$\frac{\pi\, 1.5 \times 3.456}{12} = 1.357 \text{ cu. in.})$$

At 1.276 on D read 1.628 on A
At .857 on D read .735 on A
To 1.276 on D set .857 on CI
At index of C read 1.093 on D
Perform the indicated addition and
to 1.5 on D set 12 on C
At 3.456 on C read 1.357 on DF

PROBLEM 8

Suppose you desire to figure the volume and weight of a round lead bullet, diameter .468 of an inch.

SOLUTION

Volume of a sphere $= \frac{\pi}{6} d^3$ when d = diameter.

Weight of the given sphere in lead $= \frac{\pi}{6} (.468)^3 \times 2880 = 154.5$ grains

To .468 on D set .468 on CI
Indicator to .468 on CF
6 on CF to indicator
At 2880 on C read 154.5 on DF

PROBLEM 9

Another practical problem applies very definitely to the design of new bullets and the determination of their weight before any attempt is made to manufacture a mould. One can thus closely approximate a desired weight without the expense of regrinding or manufacturing new cherries. Visualize the following bullet and sketch it briefly on a scrap of paper that you may determine the necessary slide-rule steps. Diameter as cast, .430. This bullet is of the "man-stopper" wad-cutter type, square nose, hollow point. Overall length, .788 inch. Length from base to wad-cutter shoulder, .423 inch. Length from wad-cutter shoulder to nose, .365 inch. Diameter at nose, .350 inch. Diameter at sharp shoulder, .400 inch. The bullet will have two grooves for lubrication, width .04 and depth .03 each. In addition it will have one "V"-type crimping groove, width .02 inch, depth of V, .02 inch. The hollow nose is to be a straight cavity, diameter .140, depth .400.

First, determine volume, then weight in lead, then in alloy. The various steps are below.

SOLUTION

Volume of cylindrical part

$= r^2 \pi h = (0.215)^2 \pi\, 0.423 = 0.0614$ cu. in.

To 0.215 on D set 0.215 on CI
at 0.423 on C read 0.0614 on DF

Volume of two square-type grooves

$= 2 \times 0.04 \times 0.03\ (0.43 - 0.03)\ \pi = 0.0024 \times 0.4\, \pi = 0.00302$ cu. in.

To 0.0024 D set 0.4 on CI
at π on CF read 0.00302 on DF

Volume of V-type groove

$= 0.02 \times 0.01 \times 0.42\, \pi = 0.00027$ cu. in.

at 0.000084 on D read 0.00027 on DF

Volume of frustum of cone

$$= \frac{\pi}{12} a\ (b^2 + c^2 + bc) = \frac{\pi}{12} 0.365 \left[(0.4)^2 + (0.35)^2 + (0.4 \times 0.35)\right]$$

$$= \frac{0.365\, \pi}{12} (0.16 + 0.1225 + 0.14)$$

$$= \frac{0.365}{12} 0.4225 = 0.0404 \text{ cu. in.}$$

To 0.4225 on DF set 12 on CF
at 0.365 on C read 0.0404 on DF

Volume of cavity in nose

$= (0.07)^2 \pi\, 0.4 = 0.00616$ cu. in.

To 0.07 on DF set 0.07 on CIF
at 0.4 on C read 0.00616 on DF

Total volume of bullet

$= 0.0614 - 0.00302 - 0.00027 + 0.0404 - 0.00616 = 0.09235$ cu. in.

Weight when cast in lead $= 0.09235 \times 2880 = 266.0$ grains.

Weight when cast in 1 part tin and 20 parts lead

$$= 0.09235 \frac{21 \times 2880 \times 1855}{(1 \times 2880) + (20 \times 1855)}$$

$$= 0.09235 \frac{21 \times 2880 \times 1855}{39980} = 259.2 \text{ grains}$$

To 0.09235 on D set 39980 on C,
Indicator to 21 on C,
2880 on CI to indicator
at 1855 on C read 259.2 on D.

PROBLEM 10

This problem shows a single adaptation of the slide rule to determine the velocity of recoil. The rifle weighs 9 lbs. 3 oz. The projectile is a 173-grain, .30/06 Mark I cartridge, velocity 2725 f.s. Weight of powder charge 45 grains. The accepted formula for this problem is given below.

SOLUTION

$$V' = \frac{w + \frac{1}{2}W'}{W}$$

V' —velocity of recoil
W —weight of rifle
w —weight of projectile
W' —weight of powder

In the above formula the value of V′ is approximately 7/10 of the total or maximum free recoil of the rifle; the remaining 3/10 is the result of the secondary phase.

The secondary phase is that which takes place after the projectile leaves the barrel and is due to the reaction of the gases from the rifle upon the atmosphere; it varies as the caliber, velocity and shape of the projectile. The velocity of free recoil due to the secondary phase has been determined by experiment with the Sebert velocimeter, the value of which being added to the above formula gives the formula for the total or maximum free recoil of the rifle as expressed

$$V' = \frac{wV + 4700W'}{W}$$

in which V′ is the total or maximum velocity of free recoil of the rifle. W, w, and W′ are expressed in grains.

The above formulas, of course, can be figured in the long way by proper application of mathematics. The slide rule steps for the same problem are given below.

$$V' = \frac{wV + 4700W'}{W} = \frac{(173 \times 2725) + (4700 \times 45)}{64750}$$

$$= \frac{471400 + 21150}{64750} = \frac{492450}{64750} = 7.6$$

To 173 on D set index
At 2725 on C read 471400 on D
To 4700 on D set index
At 45 on C read 21150 on D
Perform the indicated addition
To 492450 on D set 64750 on C
At index of C read 7.6 on D

PROBLEM 11

Another ballistic problem is to determine the striking energy of a 175-grain bullet at 150 yards. The remaining velocity is determined as 2615 f.s. by mathematical calculations.

SOLUTION

$$\text{Formula: Striking energy} = \frac{2615^2 \times 175}{7000 \times 2g} \text{ ft. lbs.}$$

To 2615 on D set 2615 on CI
Indicator to 7000 on CIF
175 on CIF to indicator
At 64.32 (2g) on CI read 2658 on D

The Polyphase Duplex Trig* rule can be obtained in any store dealing in drawing materials, mathematical and surveying instruments, or general tools. It is a standard model, thus eliminating the necessity for the handloader to have one built to order. A special rule would cost an enormous sum of money. The rule is available in three lengths—five, ten and twenty inch. The ten-inch scale gives accurate results up to one part in one thousand or 1/10 of 1 per cent. Shorter lengths are not recommended. The twenty-inch scale is accurate to within one part in two thousand. With a slide rule of this nature, you can do not only ballistic computations but all forms of general mathematical problems. Each rule comes with a special 92-page problem and instruction book.

One may spend as much as is desired on accessories and can obtain with it a magnifying lens which mounts on the movable indicator. This magnifier is not essential, and while it enables accurate placing of the various units and index lines, it actually slows up the operation. The author has worked some of the more complex problems with his rule and found that the results determined with the aid of the magnifier were but slightly more accurate than when it was not used, and in most cases results were obtained in much less time without it. The excellent book accompanying this rule may also be obtained for study before one makes a purchase. These are sold through the same source of supply in your local city for 50 cents, and incidentally can be obtained, in addition, covering the various individual types of rules. They indicate in detail all instructions necessary for operation, and anyone with normal intelligence, by means of this book, can readily educate himself into quick handling of the slide rule. After becoming accustomed to it, he can use it to excellent advantage.

Slide rules are used for accurate calculations in all forms of business, and are of great assistance to handloaders. Practically any problem arising, if it can be worked out by mathematical formulas, can be solved in a small fraction of the time through the proper application of the slide rule. The above problems very clearly demonstrate what can be done. To the uninitiated, they seem extremely complicated and hard to work, but a slide rule is not a difficult instrument to master.

* Reg. U. S. Patent Office by Keuffel & Esser Co.

XXXV

RECORDS—VALUE AND METHODS OF KEEPING

THERE are two kinds of handloading fans: those who just toss together a few cartridges with no interest whatever other than that they "go off" when the trigger is pulled, and those who take their handloading seriously. The man who is really interested in the handloading game will keep records, and the more extensive records he keeps, the more successful will be his handloading. There are certain handloaders, for instance, who have an elaborate bookkeeping system. Strange as it may seem, this system, though elaborate in design and volume of records, is by no means difficult to handle; and by means of it the owner can find the information he wants *when he wants it,* and not an hour later. This, then, is one of the basic reasons for keeping records.

Another very important reason for recording data pertaining to your handloads is the establishment of certain standards of your own. By that I refer either to power, to accuracy, to a combination of both, or to the setting of sights. I have one friend, for instance, who uses a 1⅛-inch Fecker telescope of the straight target variety. This is an eight-power. He uses it on six different guns. Among these guns are three Winchester Model 54 rifles in various calibers, one of them with a heavy barrel, one Winchester 52, and one Springfield .30/06. I asked him at one time if he did not consider it a practical thing to acquire more telescopes. He said that for his purpose the single scope was very satisfactory, and by using it he was always certain of the results. And he does not find it necessary to burn over half of his excellent handloads merely to sight in. His record book enables him to shift the telescope from one rifle to another and zero it first by adjusting the mount according to readings previously determined. One, or a maximum of three shots, will enable him to correct any minor variations which may occur in different groups of loads or other unknown conditions since he last fired that particular assembly of components.

You chaps who are beginning your handloading will do well to take this particular suggestion from the handloaders of much experience. Keep records. Keep them as detailed as you possibly can, and keep them where you can find the information you are seeking. All those handloaders and experimenters whose names are familiar to you in the national magazines today have voluminous records of the loads they have assembled.

Records are very closely associated with inspection. If you find a particular load which is proving destructive to your brass cartridge cases, record these data. Do not merely throw away the load and proceed to forget about it. A year hence you may spend much time, effort and good material reloading that same unsatisfactory combination, particularly if you have loaded a great many different loads in the meantime. It is impossible to remember everything.

The system you should adopt for recording various data depends entirely upon the amount of handloading you intend to do. If you load for a great many cartridges, a far more detailed system will be necessary than if you are loading for but one or two. Experiment very slowly. If you find an unknown load, do not assemble more than ten cartridges. Then take these to the target range and try them out to determine whether or not they will prove to be entirely satisfactory. If they show good promise, load another group and continue your testing. If they are unsatisfactory, discard the loads immediately and note in your data book that you tried a few of that particular combination and found them to be unsatisfactory.

The best way of keeping this kind of data, I have found, is in a loose-leaf notebook, preferably of a size which may be inserted in the shooting kit or in the pocket of an ordinary business coat. Page size should be in the vicinity of 5½ by 8½ inches. This size is convenient, and suitable fillers may be obtained at any stationery store. The reason for using a loose-leaf notebook is that it will prove more satisfactory when you add to it, or experiment with additional loads in a given caliber. These loads may be inserted at their proper place and grouped as you desire—by powder or by bullet or by cartridge or a combination of all three.

Another interesting way of recording your data is to adopt a system such as is used by the author—a variation of the Dewey Decimal System. Properly developed, this form will give you a code number for every type of cartridge you may care to

load, either now or at a later date. In addition, it permits of a very definite classification which will enable you to tell at a glance what the particular combination of powder and bullet may be. Thus, for instance, the author steps to his ammunition cabinet and picks up a box of cartridges bearing the interesting label A-1-2-1-35. This may seem complicated, but let us briefly analyze it. The cartridge is the .38 Special. "A" is my symbol for the standard factory 158-grain Winchester bullet. The first 1 refers to the powder, which is my code number for Du Pont Pistol #5. The next figure, 2, is the particular load, essentially referring to the weight of the powder charge, while the other number 1 refers to the cartridge case. The last number indicates the number of times that load has been prepared, and naturally increases with each batch I load.

Referring to my notebook, I find this code number to be a tested load using standard factory bullets, Remington Solid Head shells and Winchester #108 primers, non-corrosive, non-fulminate type. This particular handload has a powder charge of 5 grains of #5, and on actual test at the Burnside Laboratory I obtained an instrumental velocity of 922 f.s. with a mean pressure of 17,000 pounds per square inch. When the components are varied, the symbol is changed to an entirely different type; thus the same loading with Remington shells, Remington primers and Winchester bullets would be A-1-2-2, plus, of course, the figure indicating the number of times reloaded.

Each reloader can work out his own system along these lines and use his own notebook. If it is kept handy he will never have any trouble identifying the entire story of any lot of ammunition upon which his identification symbol appears.

In addition, I use a special label for each box of reloaded ammunition. This label has progressed through various stages, and in recent years has been printed on gummed paper in a variety of colors. The cost of printing is by no means excessive, and the colors are extremely handy for identification of the caliber of bullets used, or of anything else you may choose. I use pink, pale blue, medium blue, yellow, medium green, pale green, buff, white, orange and brown, all printed on gummed paper scraps from a printer's wastebox. These are approximately the size of the top of a .38 Special box and thus may be pasted to an ammunition box of almost any size. The label is replaced with each loading.

Below is an outline of the type of label used:

CARTRIDGE .... *Load No.* ....
Shell Make .... *Resized* .... *Inside Neck* .... *Primer* ....
Bullet Make .... *No.* ...... *Weight* ...... *Diam.* ...... *Crimp* ...... *Lgth.* ......
Powder .... *Weight* .... *M.V.* .... *Pressure* ....
For Gun No. .... *Date Loaded* .... *Tools* ....
Sight Setting .... *Range* ....
Remarks ....
....

In commenting upon this label it is well to analyze the best method for filling it out. Under "Cartridge" you list the caliber. Under "Load No." goes your own private identification code. "Shell Make" is obvious. "Resized" is important. In this space you insert "Full," "Neck Only," or "New," which should indicate to your own satisfaction the type of ammunition. "Inside Neck." Here you should give the diameter of your neck-expander plug. Under "Primer" you may list not only the factory number but "NCNF," meaning "Non-corrosive, non-fulminate" (non-mercuric). This is extremely important, as many reloaders may possibly have a supply of either the old-style non-mercuric but corrosive primers or some of the early non-corrosive mercuric types. Mercuric primers should never be used for reloading, and if they *are* used, the shells should be destroyed or saved for gallery or light loads.

Under "Bullet Make" you should list "Win.," "Rem.," "FA," "Own," etc. The "Number" is left blank if of factory type. If, however, you used Ideal #308329 gas-check, this should be listed thus: "I308329GC." "Weight," of course, is obvious, as is "Diameter."

"Crimp" refers to the case neck and is marked "Yes" or "No." "Lgth." refers to *overall* length of the cartridge. "Powder," "Weight," "M.V.," and "Pressure" are quite obvious.

"For Gun No." is extremely important. If you list this information you should get the best of performance and minimize the possibility of stuck shells where the case is not full-length resized. Some chambers of guns of identical caliber will vary a few thousandths of an inch, so that shells

fired in one gun are inclined to stick in another, and it is extremely annoying to get the wrong ammunition on the range and have a cartridge stuck in your chamber. "Date Loaded" and "Tools" are obvious. Some chaps have several sets of tools in the same caliber, and since no two outfits will give identical results, shape of crimp, etc., it is important that these facts be recorded. "Sight Setting" may not be necessary on an ammunition box, but it is extremely useful and will enable a man to eliminate the necessity of experimenting with his ammunition to obtain the proper zero. Under "Range" you list the distance at which the sight setting has been obtained or the range at which the load should be used. A particular load may be excellent at 50 or 100 yards and of no practical value at 200.

Proper recording of all data will systematize your field work so that you get the maximum of sport with a minimum of unpleasant experimentation. Additional bullet data may be recorded upon the type of bullet, or if a cast bullet, upon the particular alloy. This is exceedingly important, as a great many handloaders find that one alloy gives good accuracy where another with the same load of powder and combination of primer and shell will give fair or poor results.

Handloaders should also have on hand a "scrap box." In this box one may keep all odds and ends of cartridges. Without labels and the proper recording of the loading data all handloads assembled become "scrap cartridges." Scrap cartridges, by the way, should always be grouped by the particular caliber. It is surprising to see how many odds and ends will be picked up in a few months of really serious handloading. These may be satisfactory loads, but possibly with the bullet seated a trifle too deeply or with too much crimp or some such thing, which might affect accuracy if mingled with others of that particular lot. These loads should be cast aside as soon as inspection discloses the deficiency. Scrap loads of this sort, however, will prove useful for warming up a gun on a great many occasions, particularly if they have the same general type of bullet. If they accumulate too fast, one can proceed to burn them up and salvage the shells—by the simple process of "pot shooting" when one goes to a private target range. They should, of course, never be used at a club range or when other members are shooting in the vicinity, as "pot shooting" has no place upon an organized range.

In using the loose-leaf notebook, the particular load is indicated at the top of the sheet and all

CARTRIDGE.......................Load No..........
Shell Make..............Resized..............Primer..............
Bullet Make.........Weight.........Diam.........Crimp.........Lgth..........
Powder.........Weight.........Vel.........Pressure..........
Sight Setting..............................For Gun No..........
Date Loaded..................Remarks..............................
....
....

A label used on ammunition boxes by one handloader was printed on five colors of gummed paper for identification of different loads in the same calibers

Another handloader's label. Both are exact size and will fit on .38 Special and larger boxes

Caliber..................Arm..................No..........
Bullet..................Weight..................Diam..........
Case..
Powder..............Charge..............Set..............At..........
Primer No..............Overall Length..............f.s. M. V..........
Set Sights-Met. E..........W..........Scope E..........W..........
Lot No..............Date..............Purpose..........
Remarks..............................Quantity..........

data pertaining to the accuracy, penetration and ballistics of this particular combination of components should be listed in detail on that sheet. Also many handloaders find it extremely convenient to add another form of data. That is, should the load record a full-charge combination, some tested loads that will shoot at a given range to the same point of impact may also be recorded. In other words, lot "A-7-3-2" has the same 50-yard impact as lot "B-5-2-1." By inserting these sheets in the notebook both alphabetically and numerically one may find any particular load desired at an instant's notice.

What to do with your loads after they are assembled? Naturally, the best way to pack these would be in empty shell boxes; but the handloader soon finds a tremendous scarcity of this particular commodity. He resorts to the manufacture of special boxes out of cardboard, and when as he finds this unsatisfactory he proceeds to adopt some other system. Here, again, the old shotgun shell-box system is extremely convenient, as it not only permits the stacking of large quantities of a given load in a neat stack or pile but at the same time places them in proper shape for handling in the shooting kit, should it be desired to take one batch or a series of batches to the target range. The label, of course, can be pasted on the end of the box and renewed with each use. Whatever system you adopt, simplify as much as possible while still giving a maximum of data for future reference. Unless the system is simplified, it will become so extensive as to be useless. It ceases to be useful when one is never able to find anything desired at the time he seeks it.

Keep your records. Keep them clean and under no condition destroy any. The older they become the more valuable they will be to you, as you can look back with a good deal of satisfaction and note the number of loads you have done.

There is another system of records which is by no means impractical. Many handloaders keep an inventory of all components obtained or purchased. This is of little importance in the cartridge-case field, as handloaders frequently add small batches which are donated to them by fellow shooters who use that particular caliber but are not reloading and therefore have no use for fired cases. Bullets and primers are something else again, and records of these should be kept if one desires to have a satisfactory group of loads.

When primers are purchased, each particular group should have a lot number of its own. You may call it number one or lot A. Regardless of your system, be sure to record in ink or wax crayon—not ordinary lead pencil on the back of each little container of 100 or 250 primers, depending on the method of packing—the date on which you purchased it and your particular lot number. A sheet in your loading data book should be devoted to each particular type and make of primer. Different lots may be classified as A-1, A-2, A-3, and so forth. Always list the date of purchase, and if you find it practical, you may keep a record of primers purchased at one time and the amount consumed. This, of course, requires a "live inventory," which is by no means as complicated as it may sound. Thus your records may show that on Lot A, which, according to your notes, may be Remington #1½ Pistol Primers, you purchased 1000 on May 16, 1937. The same records will show that on May 1, 1937, you loaded 300 cartridges, thus leaving a balance of 700 primers. By the time your particular lot has dwindled to 200 you have ordered another group, but your records will show that you have 1000 Lot A-2 primers and 200 Lot A-1. Common sense will, of course, tell you to consume the balance of Lot A-1 before you start on Lot A-2. It is also quite appropriate to suggest that you do not mix different lots, even of the same make. They may, of course, be identical; on the other hand, the factory may have changed the priming composition slightly, and this, while it may give fully as satisfactory or even superior ignition, will give an entirely different *form of ignition* and may thus change the point of impact of your group.

The same type of records may be kept on bullets. Bullets, however, should be classified not only by the factory number and weight but also by the diameter. Do not accept the factory's word for any bullet diameter. Select at random ten bullets from a given box. Measure each one extremely carefully with micrometer calipers reading at least to .001 inch and if possible to .0001. On each box jot down with ink or wax pencil the maximum, minimum and average of those ten bullets. Record this information at the top of your inventory sheet.

Thus it will be seen that suitable records, despite the fact that they represent some additional work, will, in short order, save considerably more than the amount of time they consume in their preparation. It is embarrassing to plan to load a certain combination only to find that, despite the fact that you "thought you had" a quantity of a certain bullet, you have far too few to attempt assembly of that particular load. Should you desire these handloads for some match, this may even let you out of the shooting, as you may not be able to get them in time.

XXXVI

MAKING MUZZLE LOADERS PERFORM

By E. M. Farris

Secretary, National Muzzle Loading Rifle Association

ONE recent convert calls it "This Muzzle-Loading Mania," but a better moniker would be "The Return to First Principles."

Whether one is interested in the round ball, flint or percussion rifles for squirrel or small game

Three prominent muzzle-loading fans get together at the National Shoot. Left to right: "Boss" Johnston of Radio Station WLW; center, Gilbert Angell, Pikeville, Tennessee; right, Walter Cline, Chattanooga, Tennessee, President of the National Muzzle Loading Rifle Association

shooting, or the types taking picket or stream-lined bullets, it is all the same: you work out your own muzzle-loading program in all its complicated details or you fall flat. Those details involve a knowledge of low-pressure powders, black or semi-smokeless, their granulations (and be it known that FFg black and FFg semi-smokeless are far from the same sizes); a knowledge of what secures most uniform ignition in each rifle in his arsenal; of the percussion caps today available, along with the great variety of sizes; the size of patching (patching of projectiles is required by the rules of the game today), and the various and numerous materials that may be used for this function—linen, cotton, oiled paper, buckskin, fish skin, frog skin and what not; what metals may be used in projectiles, and how best to find and fabricate the components into a uniform and properly shaped ball or bullet; yes, and a keen knowledge of pitch of rifling, depth and width of lands and grooves, proper cleaning of the bore and powder chamber.

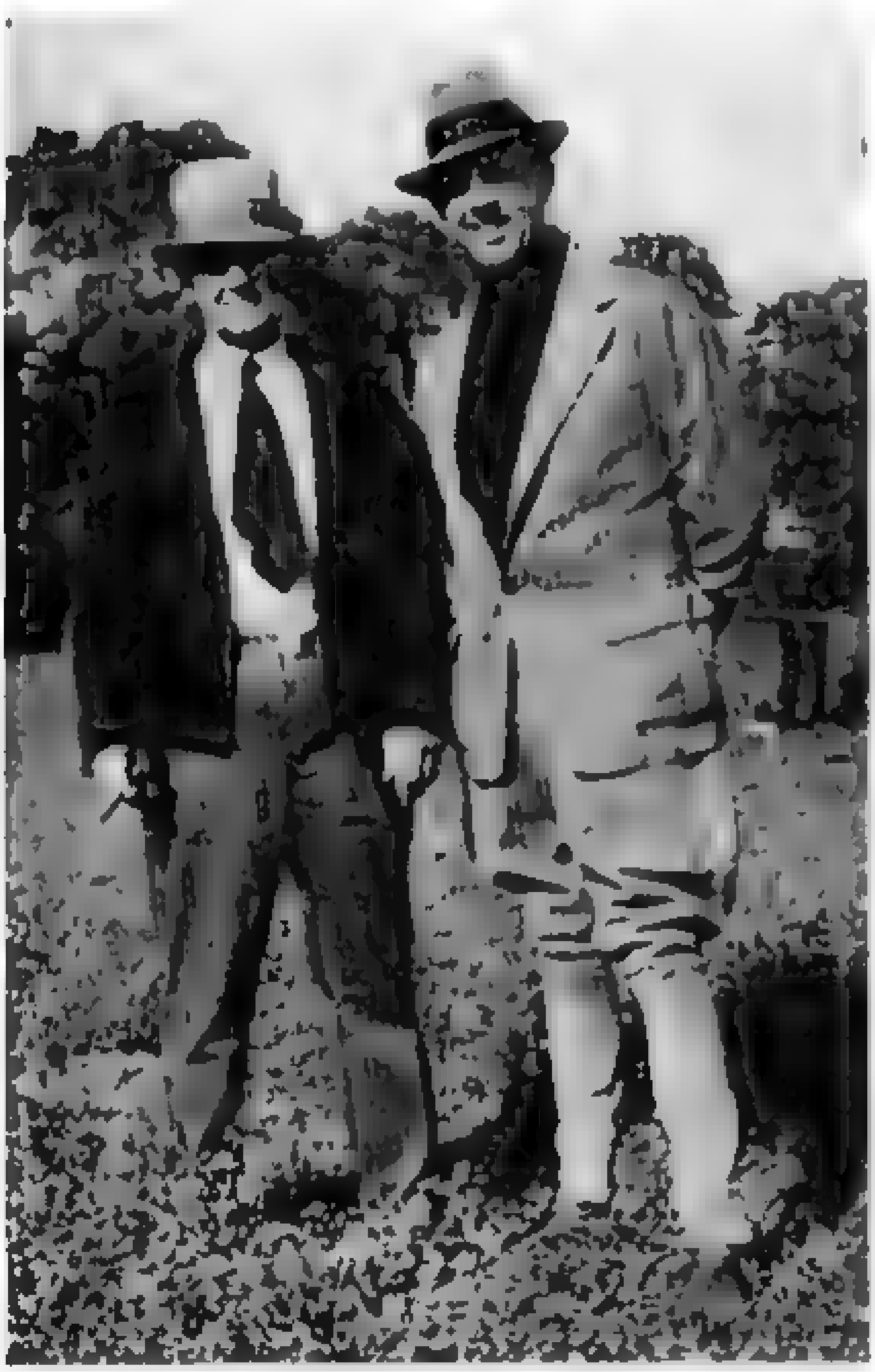
Lubrication of patches requires knowledge, and personal experience seems to be the only qualified instructor in this angle of the game. One rifle will do splendidly with a "spit patch" while another as similar as a twin brother will have an oiled patch or none. Design of stock comes in for some real study in today's development of this department of marksmanship, since the old stocks fit few of us in this generation. Then come sights, something that received but little thought in the day of the pioneer, judging from the slight change that took place between the late flint-lock period and the end of the hunting-rifle period.

Is that list anything to challenge an ambitious shooter? Don't anticipate any great progress in the revived movement if you are not willing to seek light on all those points. And do not hope to discover much of it in books. No one wrote much on these subjects in the heyday of the muzzle loader, and no one would have entirely agreed with him if he had. In short, no two who read this chapter will agree that the writer is more than a half-baked upstart in smart muzzle-loading matters—which won't be denied, if you want the whole and unadulterated truth.

In their order we are going to say something about each of the foregoing items. Nothing conclusive, just enough to whet the appetite of the

reader so he will want to dig deep and soon be able to write a book of his own on the subjects treated.

Powder. Nothing but low-pressure powders should ever be used in the old rifles. There are too many with rusted breech pins, cylinders and nipples. Modern powders would blow out so many and bring injury to such a number of rifle men as to relegate the game into disrepute in a



"Boss" Johnston and Powell Crosley, Jr., noted radio manufacturer. Both from station WLW. Mr. Crosley is a muzzle-loading fan, attending all the major matches and active in promoting this rapidly growing game

jiffy. Only black and semi-smokeless powders are safe—jot that down where it can't be forgotten. Semi-smokeless powder is a product of the King Powder Company, while sporting black can be had in King's, Hercules and Du Pont. Semi-smokeless burns "damp" and is the best for dry, hot weather, since a patch will absorb it readily. The black varieties are good, undoubtedly much better than powders of fifty to seventy-five years ago.

The writer does know that a charge of 70 grains semi-smokeless or black from a bench rest in a twelve-pound rifle almost dislocates a shoulder (the 121 pounds behind the rifle may be partly the cause of the shock), but this same rifle in 1864 was sold with the recommendation that 85 to 86 grains of Curtis & Harvey's $5 was proper. Further,

A winning combination. Walter Grote, of Canton, Ohio, with his excellent old Brockway rifle

a charge of 65 grains of semi-smokeless has given best results in experiments to date. So it *might* be inferred that the 1937 product is more efficient in foot-pounds energy, grain for grain.

The three granulations generally used by today's riflemen are Fg, FFg and FFFg—the more F's involved the finer the powder granulations. FFg might be generally recommended for the small

rifles, .25 to .33 caliber; FFg for bores from .33 to .42 caliber, and then the Fg for the really big bores. Much will depend on the ability to get your powder reasonably near the nipple and the ignition flash. It may even be necessary to use a small charge of FFFg under the main charge.

Percussion Caps. Today we have good caps made by Winchester (Staynless) and by Remington. They run in size from #9, pistol size, to the "Plug hat" musket types. Rifles and shotguns generally take 11's, 12's or 13's. We seem to find more Remington caps being demanded than any other. As these are made in two grades, trimmed and ground, we have tried both under a great variety of conditions. The ground caps are by far the better. For one thing, they are of heavier stock and do not burst and throw off slivers as do the lighter variety. Fresh stock is always available at the two factories mentioned above, and sporting-goods dealers in communities where the game is reviving may be depended upon to keep them in stock. The Winchester "Staynless" caps are very kind to nipples by eliminating corrosion dangers.

Robert Heightshoe, 14-year-old youngster of Columbus, Ohio, who won the 220-yard event at the Rising Sun (Indiana) Matches in 1936 with his Ripley rifle. The youngster took many of the old-timers over the hurdles

Patching. No, you would not need to patch projectiles today in the "bullet" guns, since there are moulds made to cast a bullet with grease grooves—"cannelures" but the rules insist they be patched if you want to get into matches. The idea is to hold to those practices that were rigid in the day when this game had reached its zenith of popularity. So patching is required In Schuetzen matches this is different, but Schuetzen belongs to another era and group. Round balls must be patched, of course. One may take the latter and

Mrs. "Tye" Holcomb, of Portsmouth, Ohio, winner of the women's 60-yard match in 1934 and 1935, and runner-up in 1936

patch them with anything that will stay with the ball on its way down the bore and back out, just so it prevents the lead from coming in contact with the harder barrel metal. Such a contact will utterly ruin a shot. Uniformity is most difficult to achieve in patching with cotton or linen fabric, since it tends to wrinkle, and it may never wrinkle twice alike. On one shot the fold may fall into a groove, and the very next shot the fold may come on a land, especially if it is a wide land. It seems to make little difference whether one uses an already cut disc patch or cuts the fabric after the ball is pushed in flush with the muzzle, but by far the majority of lovers of these round ball guns use the latter way.

No one today uses buck or fish skin for patching. Those were emergency measures in the pioneer days; they are too lacking in uniformity of thickness for match work today. In the fine, long-range match rifles the linen disc patch is still seen, but the trend is to the two- or three-strip paper patch. The disc patch will still wrinkle in these rifles, but with the false muzzles and bullet starters that are part of the equipment of the best outfits, this pesky habit is partly eliminated. Fine shooting has been seen with rifles using this patch.

In cases where the paper strip is used, it must be of a tough grade of bond or imitation parchment. Good bond is often found in fine office stationery. Good imitation parchment frequently comes wrapped around butter. The stationer and the manager of your creamery can help you if you want a source of supply. This paper should be cut "with the grain." Grain is readily noted when you get to tearing strips of the brand you happen to be experimenting with. Say you are using the two-strip patch; you must cut it so that when it folds up around the base of the bullet and is forced into the muzzle it will make a gas-tight fit. Try a few bare bullets through the false muzzle and then make your computations. Keep in mind that it takes keen figuring as to whether these strips are to fit "groove diameter" or "bore diameter." Check up on the strips after firing. Look for gas burns along the edges. After you determine the proper patch width, you will want to know what length these should be. One thing is important—that you have this patch long enough so that it will give bearing as far up on the bullet as the upsetting will expand it to bore diameter.

Balls and Bullets. Everyone knows that the round balls need to be *round* and of soft lead—just as near pure lead as can be secured. The old moulds of the pincer type that are seen with the old outfits are not, except in rare cases, fit for casting match balls. They may be rusted where the two halves come together, producing a ridge on the circumference of the projectile, or they may

Winners: E. V. ("Pete") Menefee and his prize-winning Perry rifle

be loose where the two halves are pivoted together, permitting the halves of the mould to slip one way or the other and so producing a ball that is off center and out of balance. There are a few of the old smiths left who will make much better moulds from heavier material, some of them putting on

sprue cutters and wood handles. If none are convenient for such gadgets, then the modern factories can do the work. Ideal moulds can be supplied in many round-ball sizes from stock.

Frantz Rosenberg of Norway, noted authority on firearms—both ancient and modern—and author of many American magazine articles. He is also a muzzle-loading fan and life member of the Association in the United States. Rosenberg uses two American round-ball rifles for his foreign muzzle-loading match shooting

In some cases a suitable cherry is available for immediate use, but if not, one may have to be made to order. In the latter case the cost becomes a bit high, but it is a far better way out than depending on inferior moulds and unbalanced balls.

For *bullets*—well, that is a big and controversial subject and full of dynamite. Whatever is said here can be taken as one man's opinion and not the last word by any means. To cover the range from the picket bullet that might be used in a bore with a one-turn in-44 inch-twist, to the parallel-sided bullet that came into use when the pitch was stepped up to one-in-15 inches or even one-in-12 inches, is something that can't be done properly in one paragraph of such a short chapter. The picket bullet was shaped like the pointed end of a fence picket, whence it gets its name. This projectile was often called the sugar-loaf or chocolate-drop bullet from its general shape and contour. Slow twists could handle this bullet, there being little danger of stripping with such a small bearing surface. And it did and still does shoot accurately. Harder to load than either the ball or more modern bullet, it nevertheless maintained its popularity for years as a match projectile. This bullet could easily tip in loading, and therein lies its big drawback. In loading these, the center of gravity must be maintained or the effectiveness of the shot will be ruined.

As curious and serious-minded gunsmiths got to tinkering with faster twists, they found that longer bullets, with more bearing surface, brought better grouping. Then came the era of the paper-strip patch and the passing of the linen disc in general practice. A bullet with but a twelve-to-fifteen degree forward taper may upset for three-fifths its length, and that takes us right back to the subject of patching. We will merely repeat: "Have this patch long enough so that it will give bearing as far up on the bullet as the upsetting will expand it to bore diameter." Where the match rifle takes a bullet cast in one piece, that projectile should be of lead as pure as it can be found. As these are always patched, it becomes plain that soft lead will the more surely fill the grooves without tearing the patch than would a harder composition.

Some outfits are provided with accessories that cast a two-piece bullet. The base is of soft lead, the point of a harder combination of lead and tin or antimony. The base is soft for the reason just stated; the point is hard so that the starter and loading rod will be less likely to damage this important section of the projectile. We believe the trend today is to make only the one-piece bullet, little being gained from the more laborious practice.

Anyone endeavoring to make up a batch of balls or bullets with inferior equipment ought to stop short and check up. If he finds the product is coming out with visible air holes in them, he should begin weighing each ball or bullet. He may find many of the shiny lead things far from an average weight. First thing to do is to cut open the light ones and see if there are hidden air bubbles. Likely that will be disclosed quickly enough. Then check up on methods of melting the lead and

casting the projectiles. Learn how hot the mould and the metal should be (see Chapter VIII). See if you have a proper melting pot, and BE SURE you have a dipper that is suitable. An old spoon just isn't going to serve you for proper results. When all these things have been faithfully attended to, weigh the new product. Throw out the culls and shoot only the near-perfect. Anything less is going to spoil a score when a good one is most needed.

Pitch of Rifling. Only a rattlebrain would attempt to say much on this subject—a wise man would say less. It is good advice to point out that one can learn much from the Ideal Handbook, noting what spin the .45/70 received and comparing that with the stepped-up spin of the .32/40 and the .25/35 WCF. While about it, turn to a nearby page in the Hand Book and note the charge of black powder used behind the .38/55, the .45/70 and the .44/40. Check the weight of these bullets against the powder charge (black) and file all this away for future reference. It becomes a highly instructive bit of the muzzle loader's education. This same volume will give you data on percussion-cap dimensions, this being helpful in determining which cap you need for some particular nipple. There is a table showing round balls by number or gauge, too—very much worth while. While about it, read the chapter they have on "Muzzle-Loading Arms." This short treatise may be helpful in your search for information that will lead to better accuracy with the old rifles.

Lubrication. This deals with the patching material and not bullet lubrication, which latter comes in another category. Practically all round-ball shooting with cotton or linen patching will see no oil on the patching—merely saliva. The saliva is applied to the patch just before it goes into the muzzle with the ball. This is not for a hunting rifle, where the load may stay in the bore for days, as that wet patch would tend to rust the metal. However, the beginner ought to try saliva, oil, and even graphite (dry or colloidal) on his patches. He may find a combination that only his piece will take. Anyone else might find it just so much wasted effort.

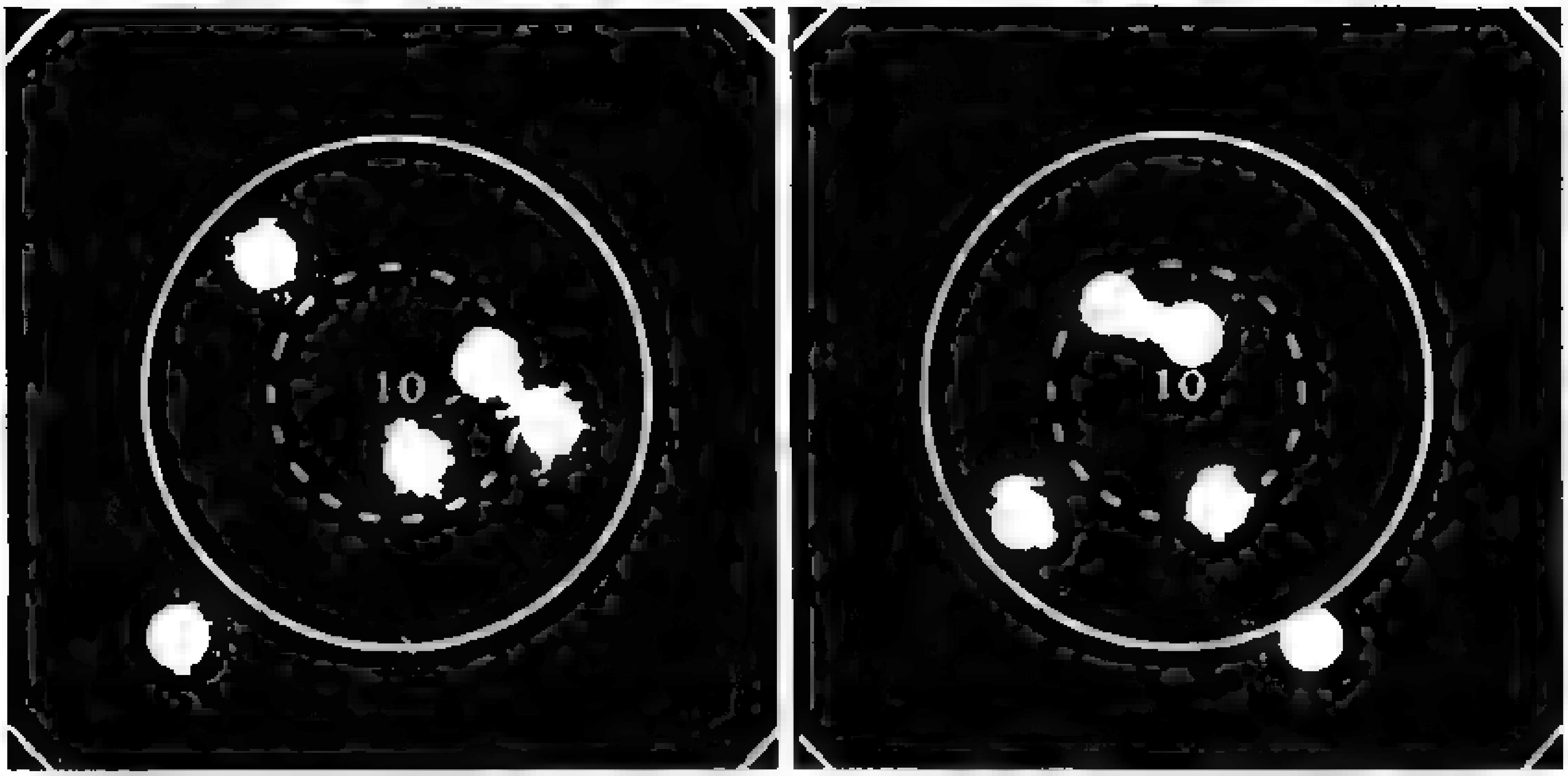
As we have earlier led the reader to believe, paper patches seem best for the bullet rifles. Paper must be lubricated. The best of the oils used seem to be sperm, skunk and neatsfoot. Take your choice; put a quantity of the strips in a tin box that will accommodate them without bending up the ends. Use but a few drops of the lubricant. Let the oil stand on for a day or so before using more, if any is needed. The strips need to be entirely impregnated, but not in an oil bath. If too much oil is present, either put in more patches to absorb it or be sure to remove the "runny" portion of the substance before loading. From the above it may be inferred that patching and lubricating are big and important items with muzzle-loading marksmen. We will drop it here and let the beginner do some experimenting on his own account.

Equipment. Sights for these rifles, design of stocks, and the other items that are readily understood today will not be treated here. Suffice it to say, a stock should be comfortable and the sights might well be the most modern. Even telescopes are being used in certain specified matches. This method of securing better definition of the bullseye and so helping one to get a better aim is not new. Brockway and Ferriss scopes on rifles made by those two gunsmiths are here by me as I write. And these telescopes truly were rugged and efficient, lacking only in light-gathering qualities and convenience of adjusting.

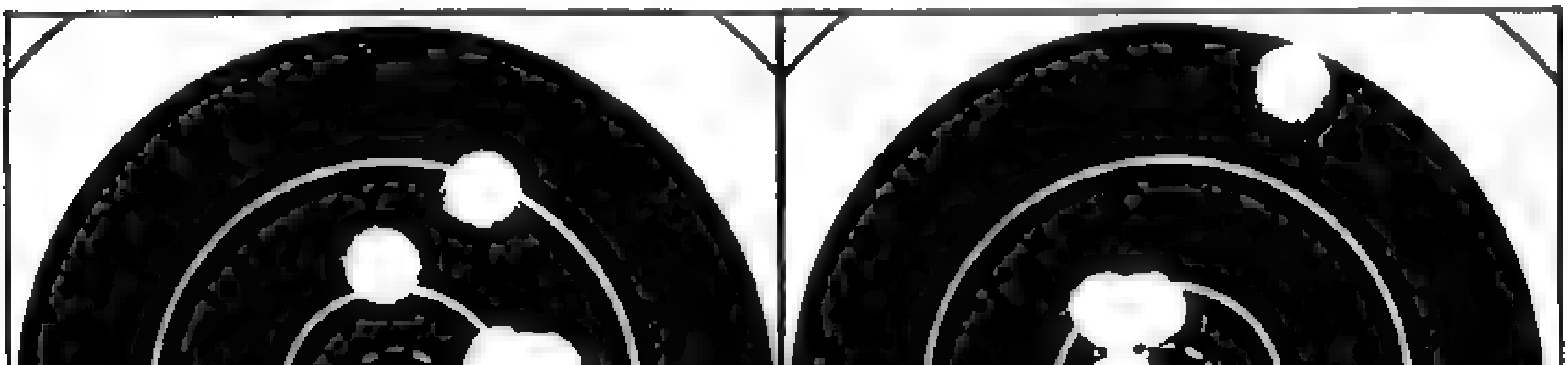
Restoring Barrels. This is a good place to tell the ambitious how to restore a good old barrel to accuracy—simply by the expedient of relining it with a modern steel rifled tube. To clinch this argument, if it is such, we may say that relined-barrel rifles in the hands of Walter Cline, President of the National Muzzle-Loading Rifle Association, and C. C. Shackleford, both of Chattanooga, Tennessee, secured scores of 96 and 97 respectively in the Boss Johnston Match at Rising Sun in 1936. These tubes were .38 caliber, relining done by D. C. Addicks, Rome, Georgia. Scoring was done from the center of the bullet hole, not the edge nearest the bullseye. Had modern scoring been applicable, Shackleford would have had 99 with 4 x's and Cline would have had 97 with 4 x's. Peep sights were used in this shooting.

In the same series of matches, Stanley Johnson, West Alexandria, Ohio, was using relined barrels and not only won the National Championship, but got first and second in so many other events as to make it necessary to send his trophies and medals in a large packing case. . . . Ben Hawkins, 1600 Brewster Avenue, Cincinnati, is another gunsmith who takes delight in making an old barrel like new by this same method. An annealed stainless steel has been used largely by Hawkins in such of his work as we have seen.

New Rifles. The growth of the revived movement makes it imperative that new rifles be put on the market very soon. Cal Price, Orange, Texas, has been making some light and medium hunting rifles—good ones, too—but it is the match types that are being called for. With modern boring and rifling machines and a knowledge of



Examples of muzzle loading accuracy. Left, official target shot in Match three by Walter M. Cline, Chattanooga, Tennessee, at the Rising Sun National Muzzle-Loading Matches of 1936. This hundred-yard target was shot with a refined barrel. Right, another target shot in the same match by C. C. Shackleford, of Chattanooga, Tennessee. This is also a refined barrel. Note the muzzle-loading scoring system. Despite the fact that this would normally be classed as a 50 with 3 X, the muzzle loading boys measure from the center of the bullet hole. Therefore this counts as a 49 with 3 X.



Two targets shot by C. L. Stants of Wichita, Kansas, in the fifty-yard match of the National Muzzle-Loading Rifle Association, at Rising Sun in 1936. These targets were shot with round ball and open sights. Score 46 and 48, a total of 94. This shows that the old guns can be made to shoot accurately.

metals and woods such as was not to be had fifty years ago, it seems this venture should interest some real smiths shortly. A really ambitious mechanic could find one or two fine rifles for his patterns, then make modifications as the customers required them. It is certain they would not want stocks on the old specifications. Modern lines would be more to their liking. Better locks, better triggers and improved sights would soon put a modern product ahead of most of the old guns, but hardly all of them. Who will be first to attempt this?

It is certain to prove of interest to many to hear which rifles have been winners in the past few years. I think the first to attract attention in a big way was the WHITMORE outfit brought to Portsmouth in 1934 by Walter Cline for the first 220-yard muzzle-loader match in the current generation. Cased and swathed like the prized jewel of a maharaja's collection, this piece was a marvel to the twenty-odd entrants. Cline let several shooters use it. It won first, third, fourth, fifth and sixth places. "Cap" Richards, noted trick and fancy exhibition shooter, watched those picket bullets go down over the course with a spotting scope and says if someone had only been wise and adjusted for three inches left windage, the top score should have been a possible.

The rifle that won second that day was a RIPLEY owned by Burrell P. Shirey, Columbus, Ohio. This same rifle tied for second the next year, then won first in 1936 in the hands of 14-year-old Robert Heightshoe, whose father had presented the cup that revived this long-range shooting. Never a top-flight gun, but always a contender, was a fine RAMSDELL, Bangor, Maine, owned by C. R. "Bull" Ramsey, Portsmouth. In 1934 this rifle and Cline's WHITMORE got into a cat-and-dog fight at Rising Sun at 100 yards, peep sights. The margin was slim and the scores keen, but not as keen as those by Cline and Shackleford in 1936 with the relined barrels.

It was a fine BROCKWAY in the hands of Walter Grote, Canton, Ohio, that carried off more honors than any bullet rifle since the old game came back to life. Possibles at 100 yards are not rare. In 1935 Grote and his Brockway won the 220-yard match with a 95. At Canal Fulton in 1936 he got a group that scored 97, but the match was a string-measure event, and he won by many inches over the next shortest string. Clyde Dixon, Marion, Indiana, spent the better part of two seasons showing the world what a heavy round-ball rifle could do at 60, 100 and even 220 yards. He used a Buckeye Tube sight (peep) and made this rifle—a VANTREES—shoot with bullet guns and set a pace hard to beat. We have seen a target with ten shots made at 100 yards, with nine all in the 2-inch ten ring and a nice close nine.

Dixon got tired of this and purchased a PERRY outfit that began to prove it had quality right away. Shortly he got sick and sold the rifle to Joe Perry at Wichita Falls, Texas. So Perry with his PERRY got right serious and soon found he had a prize. He has sent in 5-shot groups, 100-yard range, where a five-cent piece would cover all centers. He said he "kept the good groups."

J. H. Chapman, Philadelphia, has been winning many of the long-range postal events. The name of his rifle does not occur to us at the moment. O. Royce, Seaside, Oregon, has been another keen long-range postal-match shooter. (Seaside and Santa Ana, California, are two outstanding West Coast muzzle-loading communities.)

An unusual rifle got into the 220-yard match in 1935. It was a hex-bored WHITWORTH handled by the writer. Of English make, turned out about 1865 for Sir Charles Metcalf, it had been used but slightly. Briefly, this rifle got into a tie for second place, winning out because of a mishap of the other party involved. Another such rifle is now being experimented with, and the results are uncanny at times. True to form, this rifle is not consistent one day with another. And more peculiar is the fact that it will shoot a cylindrical bullet as readily as one of hexagonal shape. Possibly the matter of a paper patch is the only item standing in the way of more consistent work by this piece. How the English did this is still something of a mystery.

The future of this grand old game is assured. Publications are helping to give it popularity with the articles they publish. The *American Rifleman* has been most liberal with its space, as witness the three articles in the March 1937 issue. The author of this volume, in his excellent department "Throwin' Lead" in *All Western Magazine,* has published many articles. Canada is beginning to make inquiries, and Norway contributes a Life Member to the National Muzzle-Loading Rifle Association—none other than the Frantz Rosenberg. Membership in this organization has grown to such a point that it will shortly become necessary to install additional facilities to handle its correspondence. Trophies and cash awards are offered from many who show an interest indicative of the American's inherent love for anything pertaining to the "patch and ball" game. And what, we ask, is more typical of America than the muzzle-loading rifle, the "original hand loader"?

PART TWO

RIFLE LOADING DATA

The following list of handloads has been carefully assembled from sources believed to be 100% reliable, and every load recommended below should be perfectly safe in all properly constructed arms in good condition. However, having no control over methods of loading, selection of components or choice of arms, neither the publisher nor author of this volume assumes responsibility in the use of these tables.

At the present time neither DuPont nor Hercules is releasing loading data in any form. Even the ammunition makers have balked on the release of information so the following tables are the only complete source of such data. These tables have been corrected since the first edition and many additional loads with the recently released DuPont powders will be found in *separate tables in the supplement.* All published loads have been tested and are believed to be safe. Load carefully.

.219 WINCHESTER ZIPPER

The latest commercial cartridge development is the .219 Winchester Zipper, released in May 1937. This cartridge, at the time of going to press, has no available commercial loading data, as private laboratories are not equipped with velocity and pressure guns to enable the testing of commercial powders. Such loads as appear below have been tested by the writer on Winchester equipment.

This cartridge is a special rim number consisting of a .25/35 Winchester necked down to .22 caliber. Despite its title the bullet diameter is essentially the same as that used in the .22 Hornet and .220 Winchester Swift number. Rifling in the standard factory barrel is .224 diameter with a 16-inch six-groove right-hand twist. Grooves are .074 inch wide. This cartridge has been about two years in the process of development at Winchester, and the author has experimented with it quite extensively, using factory loads only. Built for the Model 64 Deer Rifle of lever-action vintage, the rim number is especially adapted to single-shot actions, chiefly because of the excellent body taper, the rim and the breech pressures in the 39,000-pound class.

Factory specifications call for a bullet diameter of .2245 inch and all factory cartridges are loaded with the typical Swift style of hollow-point bullet. It is quite possible that accuracy could be improved by using some of the various spitzer soft-point numbers available. Factory bullet weights include 46 and 56 grain and with either bullet. Overall length of the cartridge is 2.260 and of the shell 1.938. This cartridge is about midway velocity between the high-speed Hornet loading and the .220 Swift, and gives excellent performance in the lever-action rifle. Preliminary tests by the author indicate that the 26-inch-barrel lever gun with standard factory load is capable of producing from 1¼-inch to 1½-inch ten-shot groups at 100 yards.

With lever-action rifles in this caliber, Winchester suggests that pressures be held down to a maximum of *under* 40,000 pounds. Therefore, in the loads tested below with canister lots of IMR #3031, it would be advisable to drop back one-half grain on the charge.

.219 Zipper

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt Chg. Grs.	M V in 26-in. Barrel	Breech Pressure	Recommended by
46	HP-Win.	2.260[1]	3031[2]	27.5	3420		Win.
"	"	"	3031	28.0	3231[3]	40,700	PBS
"	"	"	4064	29.0	3072[3]	34,900	"
56	"	"	3031[2]	25.6	3100		Win.
"	"	"	3031	25.5	2931[3]	38,500	PBS
"	"	"	4064	26.5	2816[3]	33,400	"

[1] Overall length.
[2] Special non-canister lot of IMR 3031 Winchester factory standard load; other powders are canister grades.
[3] Instrumental velocity at 75 feet.

.22/15/60 STEVENS

This cartridge was an outgrowth of the .22 WCF or .22/13/45 as it was generally known at

that period. The 1899 Stevens catalog says, in describing this number:

"We do not claim that this cartridge is suitable for target work, but for light hunting purposes it was found to be an excellent load. Take it with an express bullet weighing 57 grains backed up with 15 grains of black powder and you will have a bullet which shoots very accurately owing to the long bearing of the thing, while it further is an excellent cartridge for woodchuck and smaller game. Reduced loads may be used, running from loads corresponding to the .22 Short Rimfire or 3 grains of powder and a 30-grain lead bullet up to the full-sized cartridge with its 15 grains of powder and 60 of lead, including the .22/7/45 Remington, the .22/10/45 Stevens, the .22/13/45 Winchester, and the .22/5/40 Rimfire known as the long rifle. The shell is straight inside and with just enough taper outside to make extraction easy.

"The cartridge was originated by Mr. Charles H. Herrick, who writes us that as to accuracy he has made groups at 100 feet with factory ammunition where ten shots can be covered with a ten-cent piece so that no bullet holes will show, and undoubtedly with handloading, set triggers, machine rest, and so forth, better work can be done. As to killing power, a woodchuck struck in the shoulder at 100 yards was instantly killed by the side of his hole with a factory load. This is not a single fluke kill, but has been done times enough to make it a regular thing. With a flat bullet, hollow point, the killing power may be said to equal that of the .25/21 with its 86-grain bullet."

The bullet is .226 inches in diameter—the regular .22-caliber standard, and was originally loaded with 1 part of tin to 60 of lead. It is inside-lubricated with deep grooves, and there is a wide variety of .22-caliber bullets in the various catalogs of bullet-mould manufacturers.

.22/15/60 Stevens

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 28-in. Barrel	Breech Pressure	Recommended by
60	Lead		Unique	3.4	1400	15,000	Her.
"	"		Sharpshooter	5.7	1410	10,200	"
"	"		Du P. 1	5.0			Du P.
"	"		SR 80	6.0	1450[1]		"
"	"		FFg	15.0			"

[1] Estimated velocity.

.22 HORNET

The Hornet cartridge is a development of the early 1930's and is a product not of one individual but of a series of expert riflemen, toolmakers, and experimenters at that time located at Springfield Armory, Springfield, Mass. Captain G. L. Wotkyns, Mr. A. L. Woodworth, Colonel Townsend Whelen, and others were directly responsible for this development.

Essentially the .22 Hornet is a modernized version of the old-style .22 WCF. Chamber specifications, however, were greatly refined, and the old black-powder lead-bullet load was abandoned in favor of the metal-jacketed high-velocity type of loading. Thus it will be seen that the Hornet is not a new cartridge but a revision of the old and once popular .22 WCF—a cartridge made throughout the world and modernized many years previously in Germany with a metal-jacketed bullet and known as the 5.6 x 35R *Vierling*. In Germany this cartridge is loaded with bullets weighing 38.6 grains, 40.0 grains, and 46.3 grains, in full metal-jacket, lead, soft-point flat nose, soft-point round nose, and hollow point. In the United States it is regularly loaded with a standard 45-grain soft point, and 45- and 46-grain hollow point. In developing this cartridge, after the original refinement of the cartridge case itself, the experimenters used the regular 5.5-mm. Velo Dog revolver bullets, reswaging them to a full metal jacket for some experiments, and swaging others by reversing the base and nose and thus forming a soft-point type of construction. The Springfield Armory boys interested Winchester in the experimental work, and this firm then began the manufacture of the cartridge.

The .22 Hornet cartridge is unique in the fact that all the major ammunition manufacturers were building this ammunition and selling it widely before there was a commercially manufactured gun to handle it. The original Hornet was a .22 Mark I Springfield rifle altered at the Springfield Armory. As news of this development became public, the various gun makers began rebuilding assorted rifles, from the old Winchester single-shot in that caliber, up to modern bolt-action types to handle it. The Winchester people announced the first commercial Hornet rifle in their Model 54 line.

This new cartridge is a good proposition for handloading. Excellent accuracy can be obtained—probably the finest from any of the small-bullet centerfire type. Standard factory bullets cost the small sum of 75 cents per hundred. Cartridge cases will last indefinitely if used with non-mercuric primer. Do not, however, attempt to load Peters cases, as these are factory-primed with a mercuric type and are extremely dangerous to han-

dle. With three different batches, the author has had the head come off from four different cases with the first handload, spilling gas back through the action. Similar reports have been obtained from various sources, and this warning is published in the interest of safety. No trouble is experienced, however, with new Peters cases primed with Remington or Winchester non-mercuric non-corrosive types. Best performances can be obtained at any velocity with the soft-point rather than hollow-point type of bullet. The latter is by no means reliable or safe. Experiments conducted by the author by shooting into various types of turfed fields at little white sticks shoved into the ground as markers and using all makes of factory hollow-point loads clearly indicated that more than 60% of the hollow-pointed bullets will ricochet on turf. Similar tests were conducted with soft-point bullets under identically the same conditions. Not one bullet ricocheted, and complete upset was obtained in almost any form of ground, both soft and hard. Hollow-point bullets which did not ricochet and which were recovered after an extreme amount of digging merely showed elongation where the core had flowed forward in the jacket. Accuracy with the hollow point is approximately the same as with the soft point, but in no way superior, particularly with identical loading.

R. B. Sisk of Iowa Park, Texas, makes an excellent line of bullets for this caliber. Be sure to specify the groove diameter of your rifle in ordering, as he has them to fit a great many different types of bores; both full jackets and soft-point can be obtained in 35- and 40-grain weights. Soft-point round-nose and soft-point pointed can be obtained in the 55-grain and a soft-point spitzer in 63-grain. This number is one of the finest varmint cartridges ever developed, but unless solid bullets are used, is not satisfactory for hunting small game that one desires to eat, as it is extremely destructive. It was designed as a woodchuck and crow cartridge and is being used throughout the United States in large quantities today. Best powders for loading this are Hercules 2400, and Du Pont 4227, the latter the newest number of the Du Pont line. Du Pont 1204 is less satisfactory, as the tin incorporated in the powder produces more or less fouling; also this particular powder will not permit of as high velocity as 2400 and 4227.

It might be well to note that, advertising literature to the contrary, factory loads do not develop over 2500 f.s. Any factory velocity can be duplicated by handloading. In a good rifle the cartridge is capable of 1-inch groups, and the author has shot a number of rest groups at 100 yards which ran as small as ¾ of an inch.

.22 Hornet

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in Barrel	Breech Pressure	Recommended by
35	Sisk	.099	2400	7.0	1900		Her
"	"	"	"	9.5	2540	27,000	"
"	"	"	"	11.6	3020	42,000	"
"	"	"	"	12.0	3100	45,000	Sisk
"	"	.125	1204	8.0	2007	24,660	"
"	"	"	"	9.0	2138	26 480	"
"	"	.10	"	11.5	2492[3]	33,760	JBS
"	"	"	"	12.1	2607[3]	35,430	"
"	"	"	"	12.3	2745	35 500	"
"	"	"	"	12.5	2692[3]	40,000	"
"	"	"	SR 80	4.5	1500		Sisk
40	"	.155	2400	7.0	1870		Her.
"	"	"	"	9.5	2460	28,400	"
"	"	"	"	11.2	2860	42,000[1]	"
"	"	"	1204	10.5	2295[3]	35 200	BEC
"	"	"	"	11.0	2442[3]	40 200	"
"	"	"	"	12.0	2637	38 240	Sisk
"	"	"	SR 80	5.0	1500		"
43	Ideal Lovern GC	To Rifling	SR 80	4.5	1500[4]		HGL
"	"	"	"	5.0	1540[4]		"
"	"	"	2400	7.5	1950		"
45	SP	.196	Unique	3.5	1480	20,000	Her.
"	"	"	"	4.7	1955	34 000	"
"	"	"	2400	6.0	1665		"
"	"	"	"	8.0	2100	28 500	"
"	"	"	"	10.4	2640	42,000[1]	"
"	"	.155	"	11.0	2750	46,000[1]	JBS
"	Z2	To Rifling	"	10.7	2521[4]	44,000[1]	AW
"	HP	.229	"	5.0	1475		Her.
"	"	"	"	8.0	2100	26,200	"
"	"	"	"	10.3	2605	42,000[1]	"
"	SP	1.720	SR 80	4.0	1350		Du P.
"	"	"	"	5.2	1680		"
"	"	"	"	3.5			WOCE
"	"	"	"	4.1			"
"	"	.229	1204	7.0	1590		Du P.
"	"	"	"	8.3	1850		"
"	"	"	"	9.6	2115		"
"	"	"	"	10.5	2300		"
"	"	.20	4227	8.8	2045		"
"	"	"	"	10.8	2410		"
"	Lead	.250	SR 80	4.4	1400		"
"	"	"	"	4.7	1620		"
"	"	.229	Sharpshooter	5.8	1558[5]	10,900	Her.
48	Ideal GC	To Rifling	SR 80	4.0			WOCE
"	"	"	"	4.5			HGL
"	"	"	"	5.0			BRC
"	"	"	2400	8.0			HGL
"	"	"	1204	9.0			BEC
"	"	"	"	10.8	2350		"
"	"	"	Kings Semi FFg	12.0			
55	Sisk	.274	Unique	3.0	900	16,600	Her.
"	"	"	"	4.3	1555	34,000	"
"	"	"	2400	6.0	1580		"
"	"	"	"	7.5	1965	26,200	"
"	"	"	"	9.3	2340	42,000[1]	"
"	"	"	"	10.0	2500	46,000[1]	JBS
"	"	.25	1204	9.0	1987	35,500	Sisk
"	"	"	"	10.0	2164	42,400[1]	"
"	"	"	"	10.5	2250	45,000[1]	"
60	Lead	.350	SR 80	5.1	1400		Du P.

[1] Extra-strong rifles only.
[2] Instrumental velocity at 53 feet.
[3] Estimated velocity
[4] Instrumental velocity at 78 feet.
[5] Velocity with corrosive primer.

See WARNING on page 217 of Supplement before using these loads.

.22/3000 LOVELL

This cartridge was designed by Hervey Lovell of Indianapolis, Ind. In developing it he used the .25/20 Winchester single-shot cartridge, necking it down to .22 caliber and using various Hornet bullets. Designed about 1933, the Lovell cartridge has

grown in popularity by leaps and bounds, offering, as it does, all the accuracy of the Hornet plus a velocity in the vicinity of 3000 f.s. Its major disadvantage is that special swaging dies must be obtained from Mr. Lovell for reforming .25/20 shells. The job is not very difficult, however, when equipment is on hand. The shells, once reformed, last indefinitely, and the reforming swage can be used as a resizing die between reloadings. The best powder for reloading this cartridge is Hercules 2400. It is quite possible that the new Du Pont 4227 will prove to be equal to the Hercules number, but at this particular date no developing of loads has been made with the new powder. 1204 works better in this cartridge than in the Hornet. Maximum recommended pressures should be in the vicinity of 40,000 pounds, same as for the Hornet. For the light-weight bullets, up to 45 or 46 grains, a 16-inch twist gives accuracy; with the 55- and 63-grain Sisk bullets a 16-inch twist does not give as good performance as a faster twist of 14, 12, or even 10 with the heavier bullet.

.22/3000 Lovell

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
35	Sisk		1204	16.0	3200	41,000	Sisk
"	"		2400	14.0	3300	42,000	"
40	"		1204	16.0	3006	42,000	"
"	"		2400	14.0	3100	43,000	"
45	SP Niedner		1204	16.0	3340[1]		Lovell
"	"		HiVel 3	16.0			JBS
46	"		1204	13.8	3000		Lovell
"	"		"	15.5	3300[1]		"
55	Sisk		1204	12.5	2425	38,000	"
"	"		2400	11.0	2600	42,000	Sisk
"	"		"	13.0	2800	48,000	JBS
"	"		HiVel 2	14.0			"
"	"		"	15.0			"

[1] Estimated velocity.

.22 GEBBY

The .22 Gebby cartridge is another experimental number in which but a few rifles have been made. It shows excellent possibilities and is designed by a man who is thoroughly familiar with the historical development of these modern Magnum high velocity .22's.

The Gebby cartridge was designed by Jerry E. Gebby, 6518 Tyre Ave., Kennedy Heights, Cincinnati, Ohio. Mr. Gebby is a former smallbore Match champion and in years gone by has taken his share of trophies. He knew the late Charles Newton intimately and experimented with him on his early .22 Newton rifle. Today he still has one of the early Newton experimental jobs. For many years, however, experimental work with this Newton was held up due to improper powder and bullets available. Back in 1934-1935, Mr. Gebby became interested in modernizing this number and went to work on the job but found the Newton case to be improperly shaped. He therefore undertook experimental work with a new cartridge which he named the .22 Gebby.

This new number is essentially the 7 mm. or the .257 Roberts case necked down to .22 caliber. The .22/4000 Sedgley is also of this breed, but the two cartridges are shaped somewhat differently.

Mr. Gebby is an experienced engineer and toolmaker and he has facilities available for properly conducting experimental work. He believed that a heavy bullet was desirable and accordingly undertook his experiment using the .22 Savage Hi-Power 70-grain bullet. Various twists were used, including a 14-inch twist Savage barrel. The velocities and pressures were not properly related. His current venture with this cartridge is a special heavy barrel with a .226-inch groove diameter mounted on an original Newton action, and with necked down .257 Roberts cases. His experimental work is well worth watching, since he is undertaking this with heavier bullets than those used in the Swift, Sedgley and Niedner series.

.22 Gebby

.257 Roberts ctg. necked to .22 caliber

(Data courtesy F. C. Ness)

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
45	MC		17½	30.0			Gebby
"	"		"	35.0	3305[1]		"
"	"		"	37.5	3429[1]		"
"	"		"	40.0	3673[1]		"
"	"		"	42.5	3883[1]		"
"	"		3031	35.0	3520[1]		"
"	"		2400	20.0			"
70	Savage		17½	30.0			"
"	"		"	32.5			"
"	"		"	35.0	3197[1]		"
"	"		"	37.5	3325[1]		"
"	"		3031	32.0	3255[1]		"
"	"		"	33.0	3327[1]		"
"	"		"	34.0	3361[1]		"
"	"		1204	20.0			"

[1] Instrumental velocity at 75 feet.

.22 NIEDNER MAGNUM

The .22 Niedner Magnum is essentially a modernized version of the .22 Savage Hi-Power. Niedner not only improved the cartridge by shortening its neck, but at the same time improved the chamber measurements so that excellent accuracy could be obtained. Most Niedner loads can be used with the .22 Hi-Power, but if the situation is reversed extremely dangerous pressures will result, particularly with maximum loads. The Niedner Magnum cartridge is, of course, a custom-built

proposition and intended for use with various custom-built and standard heavy bullets up to 70 grains weight. It is capable of extreme accuracy, and with proper loading can be depended upon in a good barrel to produce one-inch groups at 100 yards.

During the year 1936, Adolph O. Niedner developed an improved Niedner Magnum cartridge. Instead of using the .22 Hi-Power for his earlier experiment, he used the .25/35 case, which is essentially the same except that it permits of proper necking with a surplus of metal. Some .22 Hi-Power Savage cases were a bit undersized, and therefore would not form properly in Niedner-made swages. Niedner, of course, supplied most of these cartridge cases properly reswaged on special order. His new development uses the .25/35 case with a much more gradual shoulder taper, which should be far superior to the older form. N. H. Roberts, of .257 Roberts fame, has long since used this new development, and reports that it will develop velocity almost equal to the .220 Swift at a much lower pressure and maintain a higher standard of accuracy. For full loading data on the new development write to A. O. Niedner, Dowagiac, Michigan.

.22 Niedner Magnum
(Old Style)

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 26-in. Barrel	Breech Pressure	Recommended by
35	Sisk	.105	2400	12.0	2250	14,100	Sisk
"	"	"	"	18.0	3266	35,100	"
40	"	.151	"	12.0	2302	15,800	"
"	"	"	"	18.0	3149	44,100	"
"	"	.193	"	18.0	3100	43,800	JBS
45	SP	2.25[1]	3031	28.0	3300[2]	Max.	"
"	"	"	HiVel 3	26.0	3700	50,000	Her.
"	"	"	4198	24.0			JBS
"	"	"	"	25.0			"
"	"	"	1147	28.0	3300		"
"	"	"	HiVel 2	29.0	3650	50,000	"
"	"	"	17½	29.0	3326		R in R
"	"	"	18	26.0			"
46	OP Win.	2 1/16[1]	17½	26.0	3000[2]		HAD
"	"	"	1147	28.0	3150[2]		"
"	"	"	Pyro	24.5	3100[2]		"
"	"	"	HiVel 3	24.0	3500[2]		"
"	"	"	3031	27.5	3350[2]		"
"	"	"	4198	23.0			JBS
"	"	"	"	24.0	3400[2]		HAD
"	"	"	"	25.0			JBS
55	Sisk	218	Pyro	16.0	3000	39,000	"
"	"	"	20	26.0	3000	39,000	Sisk
"	"	"	HiVel 2	25.0			JBS
"	"	"	"	26.5	3250	50,000	"
"	"	"	17½	27.0	3200		"
"	"	"	"	28.0	3300[2]	50,000	Sisk
"	"	.274	2400	15.5	2634	34,100	"
"	"	218	"	18.0	2834	52,000	JBS
"	"	"	3031	26.0	2900	40,000	Sisk
"	"	"	"	26.5	2940	41,000	HAD
"	"	"	"	29.0	3200	43,000	Sisk
"	"	"	4064	26.0			HAD
"	"	"	"	27.0		Max.	"
"	"	"	4198	22.0		Max.	JBS
"	"	.274	15½	27.0	3200[2]		Sisk
"	"	.218	"	28.0	3300[2]		HAD
"	"	"	HiVel 3	23.0	3245	48,000	"
"	"	"	"	23.5	3290	50,000	Sisk

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 26-in. Barrel	Breech Pressure	Recommended by
55	Sisk	.218	18	24.0			R in R
"	"	.274	1147	29.0	3012[2]		Sisk
63	"	.265	3031	25.0			"
"	"	"	"	27.0	3100	43,000	"
"	"	"	4064	25.0			JBS
"	"	"	"	25.8		Max.	HAD
"	"	"	17½	28.0	3247	52,000	Niedner
"	"	"	18	23.5			R in R
"	"	"	HiVel 2	24.0	3000	49,000	Sisk
"	"	"	HiVel 3	22.5	3040	50,000	"

[1] Overall length.
[2] Estimated velocity.

.22 SAVAGE HI-POWER

The .22 Savage Hi-Power was designed in the late 1890's by Charles Newton, who sold the rights to the Savage Arms Company. This firm developed the Model 1899 Savage rifle for this particular cartridge, with its light 70-grain bullet, and announced it under the title "The Imp." It was never extremely popular as a hunting rifle, as the light bullet, particularly of the construction used in that period, was never satisfactory for game as large as deer; and upon contact with brush the tiny bullet was inclined to disintegrate. Proper twist for barrels handling this bullet is 1 turn in 12 inches. With a properly made barrel and suitable handloading, particularly with bullets lighter than the factory standard, it proves to be an excellent varmint cartridge. This is notably true when it is used with solid-frame rifles. With the takedown variety, it is inclined to be extremely erratic in shooting—a fault of the rifle rather than of the cartridge.

.22 Savage Hi-Power

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in Barrel	Breech Pressure	Recommended by
35	Sisk	105	2400	12.0	2250	14,100	Sisk
"	"	"	"	17.0	3200	34,000	"
"	"	"	"	18.0	3260	35,100	"
"	"	"	"	19.0	3367	50,100	"
40	"	.151	"	12.0	2302	15 800	"
"	"	"	"	14.0	3000	40,000	"
"	"	"	"	18.0	3149	44 100	"
"	"	"	"	19.0	3284	49,600	"
45	Hornet	.193	"	10.0	2000		Her.
"	"	"	"	13.0	2480	21 000	"
"	"	"	"	15.0	2790	28,800	"
"	"	"	"	17.4	3150	40,000	"
"	"	"	"	19.0	3410	50,000	"
"	"	"	HiVel 2	13.0	1720		"
"	"	"	"	23.0	2940	26,400	"
"	"	"	"	29.5	3780	50,000	"
"	"	"	HiVel 3	15.0	2280		"
"	"	"	"	21.0	3085	28,200	"
"	"	"	"	26.5	38.0	50,000	"
"	"	"	Sharpshooter	13.0	2485	19,500	"
"	"	"	"	18.2	3250	40,000	"
"	"	"	Lightning	12.0	1900		"
"	"	"	"	19.0	2760	25,600	"
"	"	"	"	25.7	3600	50,000	"
"	Lead	.180	GR 75	2.0	1090		Du P.

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style .. Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
45	Lead	180	GR 75	3 0	1330		Du P.
"	"	"	"	4.0	1500		"
50	GC	.250	17½	16.0	1965		"
"	"	"	"	22.0	2610		"
"	"	"	Unique	4.0			Her.
53	Lead	.213	Unique	7.5	2012	18,200	"
"	"	"	GR 75	4 0	1025		Du P.
"	"	"	"	6.0	1410		"
"	"	"	"	9 0	1655		"
"	"	"	"	11.0	2010		"
"	"	"	"	13 0	2164		"
"	"	"	Sharpshooter	12 0	2170	18,500	Her.
55	Sisk SP	.274	2400	12 0	2140	19,500	"
"	"	"	"	15.5	2634	34,100	Sisk
"	"	"	"	16.9	2780	40,000	"
"	"	"	"	18.0	2834	51,800	"
"	"	"	HiVel 3	25 2	3350	50,000	"
"	"	"	HiVel 2	28.0	3260	50,000	"
"	"	.225	3031	25 0	2859	34,160	"
"	"	"	"	30.0	3260	42,500	"
"	"	"	17½	27 0	3040	39,120	"
"	"	"	20	26.0	3009[1]		"
"	"	"	15½	27.0	3200[1]		"
"	"	"	1147	29.0	3012[1]		"
"	"	"	17½	28.0	3300[1]		"
60	GC	.375	SR 80	13.0	2050		Du P.
"	"	"	Sharpshooter	12.0	1975		Her.
"	"	"	GR 75	5.5	1370		Du P.
"	"	"	"	8.5	1600		"
63	Sisk SP	.243	2400	11.0	1960	20,000	Her.
"	"	"	"	16.2	2585	40,000	"
"	"	.320	17½	28.2	3030	41,000	Sisk
"	"	"	3031	28.0	3000	42,000	"
"	"	"	HiVel 2	26.0	3040	49,000	"
"	"	"	HiVel 3	23.0	3100	49,000	"
67	Lead	.342	Unique	6.5	1720	18,200	Her.
70	SP	.341	2400	8.0	1580		"
"	"	"	"	11.0	1930	20,000	"
"	"	"	"	13.0	2182	26,000	"
"	"	"	"	16.2	2600	40,000	"
"	"	"	"	17.6	2770	50,000	"
"	"	"	HiVel 2	10.0	1160		"
"	"	"	"	20.0	2410	24,600	"
"	"	"	"	25.4	3070	50,000	"
"	"	"	HiVel 3	10.0	1500		"
"	"	"	"	18.0	2550	26,800	"
"	"	"	"	22.6	3150	50,000	"
"	"	.400	SR 80	11.0	1825		Du P.
"	"	"	"	13.0	2050		"
"	"	"	17½	21.8	2310		"
"	"	"	"	28.1	2900		"
"	"	"	18	22.0	2310		"
"	"	"	"	26.9	2860		"
"	"	"	"	27 9	2950		"
"	"	"	3031	21 0	2375		"
"	"	"	"	27.0	2900		"
"	"	.341	Unique	7 0	1620	19,500	Her.
"	"	"	"	10.7	2270	40,000	"
"	"	"	Her. 300	28.2	2925[2]	43,100	"
"	"	"	Her 308	26.0	2840[2]		"
"	"	"	Sharpshooter	19.6	2910[2]	43,500	"
"	"	"	16	27 8	2950[2]		Du P.
"	"	"	21	24.3	2900[2]		"
"	"	"	Unique	13.0	2400	48,000	Her.
"	"	"	Sharpshooter	11.0	1920	19,600	"
"	"	"	"	16.9	2700	40,000	"
"	"	"	Lightning	10.0	1390		"
"	"	"	"	18.0	2330	27,000	"
"	"	"	"	23.0	2920	50,000	"
"	"	.40	4320	24 0	2450		Du P.
"	"	"	"	30 0	2930		"
"	"	"	4198	15.0	1990		"
"	"	"	"	21.0	2705		"
82	Lead	.613	Unique	7.0	1680	24,600	Her.

[1] Extra-strong rifles only.
[2] Corrosive primer load

.22 NEWTON

Although rarely found today, a number of rifles chambered for the .22 Newton cartridge were manufactured. This was essentially the .30/06 cartridge case, necked down to .22 caliber. Newton designed a special 90-grain bullet and drove it at a muzzle velocity of 3100 f.s. To rotate this long bullet required a twist of 1 turn in 8 inches. Rifles chambered for this cartridge with a slower twist do not give good accuracy. The cartridge was an outgrowth of the 1908 to 1912 experimental work of A. O. Niedner and others, including N. H. Roberts and Dr. F. W. Mann. It was designed about 1914 and appeared on the market as manufactured by the Newton Arms Corporation in 1918 or 1919. Previous to this, Charles Newton hand-swaged his cases from standard .30/06 type.

.22 Newton

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt Chg. Grs.	M V in 26-in. Barrel	Breech Pressure	Recommended by
90	MC		15½	40.0	3100		HAD
"	"		10	39.0	"		"

.22/4000 SEDGLEY

This cartridge was designed in the laboratory of Reginald F. Sedgley, noted Philadelphia custom gun maker. Its history is extremely interesting. Toward the end of 1934, interest in a proposed new cartridge superior in performance to the Hornet and .22/3000 Lovell seemed to sweep the country, particularly among experimental riflemen equipped to do special chambering jobs. As a direct result of this, a great many different types were privately developed, including the original .220 Wotkyns. This latter cartridge never appeared on the market, although samples of it, all hand-made, of course, are in the author's possession. It was a .250 Savage necked down to .22 caliber. Although it performed excellently, it indicated quite plainly that a larger capacity cartridge case was necessary, and a number of experimenters went to work with the Springfield and other military cartridge cases, necking them down.

J. B. Sweany, Captain G. L. Wotkyns, and others cooperating with the author, have been experimenting extensively with the 7 mm. cartridge necked down. On a visit with Mr. Sedgley at his home early in 1935, I gave him a confidential report of my experimental work with the 7 mm. only to find that Mr. Sedgley had been working independently on the same problem for some months, and that he had practically duplicated my findings. Much of the Sedgley development work was the product of the brain of George Schnerring, former laboratorial genius of Frankford Arsenal, now associated with Mr. Sedgley. Early in the summer

of 1935, Mr. Sedgley announced his new .22/4000 cartridge and began to supply both rifles and hand-loaded ammunition from his Philadelphia shop. The cartridge is a very excellent one for reloading, and most of the loading data given below were prepared for this book by Mr. Schnerring. A 16-inch twist works excellently if bullet weights are held to a maximum of 48 grains. When heavier bullets are used, a 14- or 12-inch twist is superior.

.22/4000 Sedgley

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Over-all Length	Kind	Wgt. Chg Grs.	Ins. V 24-in Barrel	Velocity Taken at	Recom-mended by
46	Sisk	2.74	3031	40.0	3750	53 ft.	Sedgley
"	"	"	"	42.0	3890	"	"
"	"	"	"	43.5	4012	"	"
"	Win.	2.58	"	24.0	2341	78 ft.	"
"	"	"	"	26.0	25.8	"	"
"	"	"	"	28.0	2686	"	"
"	"	"	"	30.0	2850	"	"
"	"	"	"	32.0	3025	"	"
"	"	"	"	34.0	3180	"	"
"	"	"	"	36.0	3335	"	"
"	"	"	"	38.0	3450	"	"
"	"	"	"	40.0	3657	"	"
"	"	"	"	42.0	3826	"	"
"	"	"	"	43.5	4012	"	"
"	"	"	4064	44.0	3910	"	"
"	"	"	"	45.0	4000	"	"
55	Sisk SP	2.78	3031	26.0	2581	"	"
"	"	"	"	28.0	2740	"	"
"	"	"	"	30.0	2908	"	"
"	"	"	"	32.0	3070	"	"
"	"	"	"	41.0	3658	"	"
"	"	"	"	42.0	3778	"	"
"	"	"	4064	44.0	3783	"	"
"	"	"	"	45.0	3862	"	"
56	Win. OP	2.70	3031	33.0	3240	53 ft.	"
"	"	"	"	35.0	3393	"	"
"	"	"	"	37.0	3513	"	"
"	"	"	"	39.0	3643	"	"
"	"	"	4064	33.0	3200	78 ft.	"
"	"	"	"	35.0	3398	"	"
"	"	"	"	37.0	3505	"	"
"	"	"	"	39.0	3580	"	"
"	"	"	"	43.0	3687	"	"
63	Sisk SP	2.78	3031	26.0	2544	"	"
"	"	"	"	28.0	2660	"	"
"	"	"	"	30.0	2820	"	"
"	"	"	"	32.0	3010	"	"
"	"	"	"	34.0	3132	"	"
"	"	"	"	36.0	3240	"	"
"	"	"	"	38.0	3346	"	"

.22 NEWTON-KRAG

This is an excellent development which should have been pursued much further than it has been. Undoubtedly, had Charles Newton lived to see the current development of high-power .22's, he would have picked up his experiment abandoned some years ago. The Krag is superior to the various others on the market, particularly for single-shot actions, due to the rimmed type of cartridge case and the consequent ease of adjustment of head-space and extraction. This particular cartridge has been widely used by such experts as N. H. Roberts, H. A. Donaldson, J. Bushnell Smith, and others. Mr. Smith has changed the case measurements, which greatly affects the ballistics of the cartridge; his new development known as the .225 Lightning should not be confused with the Newton-Krag, although it is extremely similar. Loading data for the Lightning should not be confused with those of the Krag. With the Newton-Krag or later Smith development, the rifling should have a 14-inch or faster twist.

.22 Newton-Krag (12-inch Twist)

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seat-ing Depth	Kind	Wgt Chg. Grs.	M V in 26-in Barrel	Breech Pres-sure	Recom-mended by
70	MC		17½	33			HAD

.220 WINCHESTER SWIFT

This cartridge is purely a commercial proposition, although dozens of custom gun makers in this country chamber for this cartridge. Of the entire development of high-speed .22's, this is probably the highest-pressure proposition, having a working pressure of around 55,000 pounds. Winchester, in cooperation with Captain Wotkyns and others, conducted a great deal of research on the subject of super-speed .22's and experimented with more than a dozen different cases and case shapes before the present form was finally adopted and announced in the late summer of 1935.

The .220 Swift is a rimless cartridge case and has approximately the same inside capacity as the 6 mm. Lee. As a matter of fact, Winchester announced the .220 as having a special Lee case with a .30/06 head on it. Actually the case is the strongest for handloading ever produced commercially in the rifle series. The web of the case head is much thicker and the interior shape has been designed for the best possible combustion. Also this is of the semi-rimmed type of construction in that the actual rim, although appearing to be of the familiar rimless variety, is a bit larger in diameter than the body of the cartridge in front of the extractor groove. It is an excellent case for reloading, being extremely sturdy and of stiff brass. The neck of the case is much thicker than that used for the Springfield, and, according to the author's experience, will stand more than 25 reloads without any trouble. A batch of these cases has already been reloaded slightly more than that number of times without the slightest indication of failure.

The .220 Swift cartridge and the Model 54 Winchester rifle to handle it were first put into production at the Winchester factory shortly after the adoption of this cartridge on April 23, 1935. The first rifles for it were released in August 1935.

These have a twist of 1 turn in 16 inches of the barrel—the same as the .22 Hornet and Long Rifle. On April 15, 1936, Winchester found that greater accuracy could be obtained with a twist of 1 turn in 14 inches and officially adopted that for both the Model 54 and the new Model 70. Rifling diameter is standardized at .224, and bullets should measure approximately .2245. Barrels have six grooves, .074 inches wide, and this will prove to be most satisfactory in any custom-built rifle of this caliber. Experiments have shown that the six-groove barrels perform better with these super velocities than the four-groove type which was used by those who experimented with the Swift in its earlier stages.

Handloading the .220 Swift is a delicate operation. This cartridge is by no means perfected. It is an outstanding development—the first commercial cartridge ever to pass the 4000 f.s. velocity figure. Accordingly, this author predicts that within the next few years many minor but important changes and improvements will be made in it. Always weigh your powder charges, and do not by any means exceed the maximum recommended charges. The bullets for this particular cartridge are priced extremely high—$27 per thousand. A great many people wonder why the 48-grain Swift soft-point bullet should not be in the same price class as the .22 Hornet soft-point weighing but three grains less, or why the 46-grain Hornet hollow-point and the 46-grain Swift hollow-point cannot be interchanged. The tremendous velocity of the Swift requires a bullet with a much heavier jacket than ordinary .22's, and particularly with the heat-insulated core. Accordingly, Winchester copper-plates all cores for the Swift and uses a high percentage of antimony. Hornet bullets can be used, but no attempt should be made to reach the standard velocity with them, as the bullets are inclined to strip in the barrel or melt in midair. Maximum recommended velocity for Hornet bullet when used in this cartridge is around 3300 to 3500 f.s. However, for those who do not desire to spend nearly 3 cents apiece for their bullets, R. B. Sisk of Iowa Park, Texas, manufactures a very excellent express Magnum bullet with a tiny tip of exposed soft point—the shortest exposed soft-point spitzer ever commercially manufactured. These sell for $12 per thousand and are fully as accurate for proper handloading as regular Winchester standard, besides having a superior ballistic form. The Swift, although originally designed for a 46- to 48-grain bullet, performs excellently with bullets weighing 55 grains, and the handloader who is desirous of producing the best of accuracy plus flat trajectory and good killing power, should use a bullet weighing 55 grains and a twist not slower than 14 inches; 12 inches would be even better. Various powders can be used, but 4064, 4198 and 3031 burn much cleaner than the old "½" series. In all handloading for this cartridge, powder charges should be weighed rather than measured, and some form of grease wad should be used to lengthen barrel life and improve accuracy.

.220 Winchester Swift

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs	Ins. V 26-in Barrel	Breech Pressure	Recommended by
45	Fact		4064	41.0	4250[1]		Sweany
"	"		4198	30.0			"
"	"		"	31.0			"
"	"		"	32.0			"
"	"		Pyro DG	31.0	3300[1]		"
"	"		"	34.0	3500[1]		"
46	MC	.175	3031	37.5	3804[1]	51,000	"
"	"	"	"	38.0	3918[1]	56,500	"
"	"	"	"	38.5	3946[1]	58,500	"
"	"	"	"	39.0[3]	4140[2]	53,000	Win Her.
"	"	"	HiVel 2	20.0	2375[1]		
"	"	"	"	30.0	3280[1]	30,000	"
"	"	"	"	35.2	3920[1]	50,000	"
"	"	"	HiVel 3	15.0	1970[1]		"
"	"	"	"	25.0	3050[1]	24,700	"
"	"	"	"	33.2	3935[1]	50,000	"
"	"	"	Lightning	15.0	2150[1]		"
"	"	"	"	25.0	3200[1]	32,500	"
"	"	"	"	30.2	3745[1]	50,000	"
"	"	"	Sharpshooter	14.0	2560[1]	18,000	"
"	"	"	"	22.2	3430[1]	40,000	"
"	"	"	Unique	10.0	2300[1]	21,000	"
"	"	"	"	14.0	2840[1]	40,000	"
"	"	"	2400	15.0	2540[1]	19,000	"
"	"	"	"	20.5	3135[1]	40,000	"
48	SP	.15	3031	34.0	3500[1]		Du P.
"	"	.175	"	37.0	3871[1]	53,000	Sweany
"	"	"	"	37.5	3947[1]	55,700	"
"	"	"	"	38.0	3885[1]		Du P.
"	"	"	"	39.5	4118[1]	67,000	"
"	"	"	"	39.0	4140[2,3]	53,000	Win Her
"	"	"	HiVel 2	20.0	2225[1]		
"	"	"	"	28.0	3065[1]	27,200	"
"	"	"	"	34.8	3785[1]	50,000	"
"	"	"	HiVel 3	18.0	2300[1]		"
"	"	"	"	28.0	3340[1]	32,400	"
"	"	"	"	33.0	3850[1]	50,000	"
"	"	"	Lightning	15.0	2050[1]		"
"	"	"	"	25.0	3090[1]	29,500	"
"	"	"	"	30.4	3645[1]	50,000	"
"	"	"	Sharpshooter	14.0	2410[1]	16,500	"
"	"	"	"	22.4	3350[1]	40,000	"
"	"	"	2400	15.0	2460[1]	19,000	"
"	"	"	"	20.7	3105[1]	40,000	"
"	"	"	Unique	10.0	2240[1]	18,700	"
"	"	"	"	14.2	2835[1]	40,000	"
"	"	.15	4064	37.0	3600[1]		Du P.
"	"	"	"	40.6	4025[1]		"
"	"	"	4320	35.0	3500[1]		"
"	"	"	"	38.8	3900[1]		"
55	Sisk RN	.25	4064	34.7	3360[1]		"
"	"	"	"	38.5	3685[1]		"
"	"	"	3031	32.0	3310[1]		"
"	"	"	"	36.5	3635[1]		"
"	"	"	4320	33.5	3275[1]		"
"	"	"	"	37.5	3575[1]		"
"	Sisk Mag.	.176	3031	34.5	3650[1]	56,000	Sweany
"	"	"	4320	35.0	3750[1]	60,000	"
"	"	"	4198	30.0			"
"	"	"	"	32.0			"
"	"	"	4064	39.0	3900[1]	46,000	JBS
"	"	"	"	39.5	4030[1]	49,000	"
"	"	"	"	40.0	4075[1]	51,000	"
56	Fact	"	3031	34.5	3497[1]	56,000	Sweany
"	"	"	"	35.0	3610[1]	60,200	"
63	Sisk	"	4064	32.0			JBS

[1] Estimated velocity.
[2] Velocity taken at 53 ft.
[3] Winchester factory load.

.226 EXPRESS

This cartridge is designed by J. Bushnell Smith of Middlebury, Vt., in cooperation with a number of other experimenters, including J. B. Sweany of Winters, Calif. Essentially it is the .30/06 cartridge, not only necked down to .22 caliber but also given a long slender body taper. It performs excellently at all ranges. The various dies, swages, and so forth, can be obtained from its originator, Mr. Smith. Also various chambering jobs are done by him in this particular caliber. It is extremely accurate for long-range shooting.

.226 Express (J. B. Smith)

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 26-in. Barrel	Breech Pressure	Recommended by
55	Sisk		4064	42.5			JBS
63	"		"	40.0			"
"	"		15½	42.5			"

6 MM LEE (NAVY)

This was the old United States Navy cartridge developed for the Lee 6 mm straight-pull Navy gun, a bolt-action type of arm. It was never overly popular because the long bullet had an erratic tendency when shot. Accuracy was none too good, and barrel life was extremely short with the nitroglycerine powders in use at the time of its development. It has the quickest twist of any of the commercial cartridges on the market, although no gun is manufactured to use it at the present time. Winchester produced a sporting model 6 mm. Lee in 1898 but discontinued it about 1903. Twist as made by Remington was 1 turn in 6½ inches, and as made by Winchester, 1 turn in 7½ inches. The round-nose 112-grain bullet is not considered satisfactory, and few other bullets are available in this size.

6 mm Navy

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 28-in. Barrel	Breech Pressure	Recommended by
65	Lead	.250	SR 80	7 8	1270		Du P.
"	"	"	Unique	4.0			Her.
"	"	"	GR 75	6 0	1260		Du P.
95	"	"	SR 80	9 0	1268		"
"	"	"	Unique	5.0			Her.
"	"	"	GR 75	8.0	1275		Du P.
112	SP	.229	HiVel 2	18 0	1680		Her.
"	"	"	"	26.0	2240	20,300	"
"	"	"	"	32.6	2710	46,000	"
"	"	"	HiVel 3	14.0	1515		"
"	"	"	"	22 0	2145	31,200	"
"	"	"	"	27.2	2560	46,000	"
"	"	.250	15½	34.3	2400		Du P.
"	"	"	"	28.0	2200[1]		JBS
"	"	"	"	30.0	2300[1]		"
"	"	"	15	28.0	2200[1]		"
"	"	"	"	30.0	2300[1]		"
"	"	.229	Unique	10.0	1380	22,500	Her.
"	"	"	"	14.1	1730	37,000	"
"	"	"	Lightning	28.4	2568[2]	50,000	"
"	"	"	21	31.5	2600[2]		Du P.
"	"	"	Sharpshooter	25.5	2565[2]	53,000	Her.
"	"	"	"	14.0	1700		"
"	"	"	"	20.3	2210	37,000	"
"	"	"	Lightning	18 0	1780		"
"	"	"	"	20.0	1940	25,000	"
"	"	"	"	28.9	2615	46,000	"
"	"	"	2400	12.0	1400	20,500	"
"	"	"	"	19.5	2020	37,000	"
"	"	.25	4064	27.0	2200		Du P.
"	"	"	"	32.5	2540		"

[1] Estimated velocity.
[2] Corrosive primer load.

.25/20 SINGLE SHOT

The .25/20 Single Shot was the first of the commercial .25 caliber center-fire cartridges developed in 1882 by J. Francis Rabbeth, famous rifle shot, writer, and experimenter of the old Massachusetts

.25/20 Single Shot

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 26-in. Barrel	Breech Pressure	Recommended by
60	HP	.286	Unique	4.0	1250	12,400	Her.
"	"	"	"	5.2	1590	20,000	"
"	"	"	"	6.0	1700[1]		HAD
"	"	"	2400	8.0	1535		Her.
"	"	"	"	9.5	1815	24,700	"
		"	"	12 2	2310	40,000[2]	"
"	"	.280	"	14.0	2500	Max.[2]	JBS
"	"	"	1204	13.0	2200[1]		AHT
"	"	"	"	15.0	2421	33,180	DAD Jr
"	"	"	"	15.5	2485	37,000	"
"	"	"	"	16.0	2548	40,960[2]	"
"	"	.286	Sharpshooter	7.0	1355	12,000	Her.
"	"	"	"	9.8	1865	25,000	"
67	Ideal	"	Du P. 1	8.0			TGS
"	"	"	Schuetzen	7.0			
				8.0			AHT
74	Ideal-Loverin	2.00[3]	Unique	5.0			HAD
"	GC	"	2400	9 0	1700		"
"	"	"	SR 80	8 0	1600		"
75	Ideal GC	"	Unique	5.0			"
77	Ideal Lead	"	Du P. 1	8.0			TGS
86	SP	.397	Unique	4.5	1060	20,000	Her.
"	"	"	"	5.0	1200[4]		"
"	"	"	"	5.5	1400[4]		"
"	"	"	2400	7.0	1130		"
"	"	"	"	8.5	1450	22,500	"
"	"	"	"	10.8	1880	40,000[2]	"
"	"	"	1204	13.0	2025	38,000	DAD Jr
"	"	"	"	13.5	2090	41,460[2]	"
"	"	"	"	14.0	2180	45,880[2]	"
"	"	"	Sharpshooter	[illegible]	1408[4]	18,600	Her.
"	"	"	"	10.0	1770[4]	29,600	"
"	"	"	Unique	6.0	1467	29,600	"
"	"	"	Sharpshooter	6.0	990	12,000	"
"	"	"	"	8.6	1515	25,000	"
"	"	.40	4227	8.5	1400		Du P.
"	Lead	.423	Unique	4.7	1480	20,000	Her.
"	"	"	2400	7.0	1450		"
"	"	"	"	[illegible]	1572	19,900	"
"	"	"	"	[illegible]	1705	25,000	"
"	"	"	"	10.8	1995	40,000[2]	"
"	"	"	1204	11.0	1735		Du P.
"	"	"	SR 80	5.0	1300		"
"	"	"	"	6.8	1424		"
"	"	"	Du P. 1	9.0			"
"	"	"	Sharpshooter	7.5	1640	21,000	Her.
87	Savage	"	Schuetzen	9.0			HAD
"	"	"	1204	15.0			AHT

[1] Estimated velocity.
[2] Extra-strong rifles only.
[3] Overall length.
[4] Corrosive primer load.

Rifle Association at its Walnut Hill range. Rabbeth contributed to magazines of that period under the pen name of "J. Francis." He had eight years of practical training at the Remington plant. The original .25/20 shot was designed to use both the 67- and 77-grain bullets. Several years after the cartridge was developed, the Maynard became the first commercial rifle chambered for it, followed by the Stevens tip-up. It was a handloaded cartridge at that time. When the UMC outfit introduced the cartridge in 1886 commercially they employed an 86-grain bullet, which, despite the criticism of the riflemen of that day, has remained the standard weight up to the present. Rifles chambered for this cartridge are no longer commercially manufactured. It is an extremely popular and accurate number, and in every way superior to the .25/20 Repeater cartridge. It has a gentle taper on the bottleneck, causes little trouble, and requires little resizing when reloaded.

Barrels manufactured for this cartridge by Stevens have 1 turn in 13 inches; those made by Winchester had 1 turn in 14 inches, and those made by Remington 1 turn in 12 inches. A large variety of .25-caliber cast bullets are available for handloading as well as several of the metal-jacketed variety. Suitable powders include SR 80, Bulk Smokeless, Schuetzen, #1204, #4227, Hercules #2400, Unique, and Sharpshooter.

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
60	HP	.286	Unique	5.5	1795	20,000	Her.
"	"	"	Sharpshooter	10.8	2100[1]	27,000	"
"	"	"	Lightning	11.0	1715[1]	20,000	"
"	"	.250	1204	8.2	1265		Du P
"	"	"	"	12 2	2050		"
"	"	.300	SR 80	7 0	1630		"
"	"	.286	Sharpshooter	5.0	1190		Her.
"	"	"	"	7.0	1555	12,200	"
"	"	"	"	10.2	2120	25,000	"
"	"	"	"	11 2	2160[1]	28,000	"
"	"	.275	4227	9.7	1785		Du P.
"	"	"	"	12.7	2195		"
"	Lead	.248	Unique	4.0	1475	12,200	Her.
"	"	"	"	5.4	1835	20,000	"
"	"	"	2400	5.0	1110		"
"	"	"	"	7 0	1485	10,900	"
"	"	"	"	9.0	1930	25,000	"
"	"	.200	SR 80	4.0	1150		Du P.
"	"	"	"	6.0	1550		"
"	"	.248	Sharpshooter	8.5	1850	15,000	Her.
61	"	.200	SR 80	4 0	1060		Du P.
"	"	"	"	6 0	1500		"
60	B & M	"	"	4 5	925[2]		FM
"	"	"	"	8.0	1675[2]		"
86	SP	.397	Unique	3 5	950	10,500	Her.
"	"	"	"	4 9	1355	20,000	"
"	"	"	2400	6 5	1030		"
"	"	"	"	8 0	1475	17 300	"
"	"	"	"	9 5	1740	25,000	"
"	"	"	1204	12.5	1925[2]		FM
"	"	"	Sharpshooter	8 6	1400[1]	19 700	Her.
"	"	"	"	9 6	1756[1]	27 500	"
"	"	"	Lightning	11 0	1384[1]	23,300	"
"	"	"	"	11 7	1726[1]	32,200	"
"	"	"	SR 80	6.9	1400		Du P.
"	"	"	Unique	6.0	1570	33,000	Her.
"	"	"	Sharpshooter	5 0	830		"
"	"	"	"	6 0	1150	12 000	"
"	"	"	"	8 6	1710	25 000	"
"	"	.43	4227	8 7	1410		Du P.
"	"	"	"	10 7	1745		"
"	Lead	.423	Unique	3.0	1095	11,200	Her.
"	"	"	"	4.8	1485	20 000	"
"	"	"	2400	5.0	1020		"
"	"	"	"	6.5	1305	13 600	"
"	"	"	"	9.2	1765	25,000	"
"	"	.400	SR 80	3.4	925		Du P.
"	"	"	"	5.2	1300[2]		FM
"	"	"	"	5.5	1350		Du P.
"	"	"	"	6.3	1410		"
"	"	"	"	7.0	1475		"
"	"	.423	Sharpshooter	8 7	1780	25,000	Her.
87	SP	.400	1204	9 3	1395		Du P.
"	"	"	"	11.3	1740		"
90	BT Lead	.325	SR 80	5 0	1175		"
"	"	"	"	6 0	1300		"
117	SP	.475	SR 80	5.0	755		"

[1] Corrosive primer load.
[2] Estimated velocity.

.25/20 REPEATER (WCF)

This particular cartridge was the "modernized" version of the .25/20 Single Shot developed for Winchester and Marlin rifles with short actions designed to handle the .38/40 and .44/40 cartridges. In order to shorten the cartridge and still have a semblance of power, the case has an abrupt bottleneck, thus creating high pressures without achieving reasonable results. It is not a good cartridge for reloading, although it is widely used for that purpose. Any of the lightweight .25-caliber cast bullets under 86 grains performs reasonably well with this cartridge, and any of the powders mentioned for the .25/20 Single Shot can be used to good advantage.

.25/20 Repeater

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
60	HP	.286	2400	7.5	1450		Her.
"	"	"	"	9.0	1765	14,800	"
"	"	"	"	10.5	2075	25,000	"
"	"	.280	"	11.5	2200	32,000	JBS
"	"	.286	Unique	4.0	1430	10,200	Her.

.25/21 STEVENS

In the early 1890's riflemen were under the impression that black powder would not perform properly in a bottleneck cartridge case. Accordingly when the .25/20 Single Shot and Repeater cartridges were developed, there was a demand for the same general type of loading as in a long straight shell. About 1897 the .25/21 Stevens cartridge was developed. This cartridge, in general, was considered an unnecessary development and has been obsolete for a great many years. Rifles of this caliber, however, are frequently turned out to order by various custom gun makers

and the Parker Hale Company of England will retube a rifle barrel to take this cartridge. Shooters who have used the old .25/21 will tell you, however, that it is one of the most accurate-shooting numbers of the entire early series of small bores. Of a dimension identical with the .25/25, the .25/21 is about a half-inch shorter, far easier to extract, but by no means as easy as the .25/20 Single Shot with the better taper and bottleneck.

One old-timer who had a great deal of experience with this cartridge said, "Shooters who wanted to swap you their .25/21 never spoke a great deal about its extraction, but generally talked accuracy in its place." With a great many bullets available in .257 diameter, one can work up many a satisfactory and pleasing load. It is an economical caliber to shoot: one gets a great many loads out of a can of powder. With the proper load, and a suitable telescope, it is capable of ½-inch groups or less at 75 yards when shot from a bench rest. The best method of loading, according to N. H. Roberts, is to use a card or blotting-paper wad over the powder and seat the bullet lightly into the rifling ahead of the case. With such loading Major Roberts has been able to do ½- to ¾-inch groups at 100 yards with the 100-grain Schoyen bullet cast 1 to 30 and 9.5 grains of #1204.

.25/21 Stevens

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 26-In. Barrel	Breech Pressure	Recommended by
60	MC		2400	8.0	1527	10,500	Her.
"	"		"	11.0	2036	18,000	"
"	"		"	13.0	2370	29,600	"
86	SP	.450	SR 80	5.5	1150		Du P.
"	"	"	"	7.6	1317		"
"	"	"	2400	6.0	953	9,100	Her.
"	"	"	"	10.0	1673	18,000	"
"	"	"	"	12.0	2000	29,400[1]	"
"	Lead	"	SR 80	7.7	1440		Du P.
"	"	"	Sharpshooter	7.6	1472[2]	11,200	Her.
"	"	"	Unique	5.5	1525		"
"	"	"	Du P 1	10.0	1400[2]		Du P.
90	Schoyen 1-30		1204	11.0	1500		NHR
"	"		SR 80	3.0	1500		CAS
"	"		SS FFg	10.0	1500		"
100	"		1204	9.5	1500		"

[1] Extra-strong rifles only.
[2] Corrosive primer load.

.25/25 STEVENS

About as useless and freakish-looking a cartridge as was ever developed is the .25/25 Stevens. It was a .25/21 with an addition of about a half-inch of case length adding 4 grains to the powder capacity, but using the same series of bullets. It was developed by a Captain Carpenter of the United States Army during 1895. The .25/25 was developed first, but owing to the extreme length of the long straight shell and the tremendous problem of extraction, it was found advisable to reduce this to the shorter length, and thus was the .25/21 born. The .25/25 was the first .25-caliber straight shell manufactured by the Stevens Company. The powder chamber of this cartridge case is straight on the inside, while the outside of the case has a very straight and hardly noticeable taper. New cases measure .300 diameter at the base and .280 at the mouth, on a case 2.38 inches in length.

Handloaders who desire to reload this cartridge should bear in mind that the old-type corrosive smokeless primers are tremendously destructive to old barrels. It is best to prime these cartridges with the black-powder primer and use a small amount of black powder in the bottom of the cartridge case to aid ignition. It is best also to stick to cast bullets, as most barrels in this caliber are of extremely soft steel, and jacketed bullets will soon wear them out. No. 1 Rifle and Schuetzen smokeless for black-powder priming were, and still are, the favorite powders for this case. Du Pont #1204, Hercules #2400, and HiVel #3 also work excellently in loads developing standard velocity but should not be loaded loose in this long case, as the charge may move to the bullet end, causing hangfires. Both the .25/21 and .25/25 happen to be very few rifle cases which may be loaded with a light powder charge tamped backed against the primer by the use of a blotting-paper wad. Use a .932-inch harness punch, and make the wads yourself. Sporting rifle #80 also works well in the .25/25 case if pressures are not crowded too high, but is inclined to give extraction problems.

In loading this cartridge, when a cleaning rod becomes necessary to back out sticking shells, drop the charge back half a grain and do not attempt to exceed it. This is a better indication of pressures in this difficult-to-extract cartridge than watching primers. Always choose a full-length resizing die.

.25/25 Stevens

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg Grs.	M V in 26-In Barrel	Breech Pressure	Recommended by
86	SP	.450	SR 80	8.5	1500		Du P.
"	"	"	Sharpshooter	9.7	1560[1]		Her.
"	Lead	"	SR 80	8.0	1500		Du P.
"	"	"	Sharpshooter	8.6	1566[1]		Her.
"	"	"	Unique	5.6	1550[1]		"
"	"	"	Du P. 1	12.0			Du P.

[1] Corrosive primer load.

.25/35 WINCHESTER

This is one of the early Winchester series born at about the turn of the century and has retained its popularity throughout the years. Designed for use with the 117-grain bullet, it is capable of excellent accuracy when properly loaded. Various .25-caliber bullets in 60, 87, 100, and 117 grains in jacketed varieties, as well as many cast numbers, are available. Properly loaded, it is suitable for all game from varmints up to and including deer. In handloading it, do not exceed the 33,000-pound pressure limit.

.25/35 Winchester

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 26-in. Barrel	Breech Pressure	Recommended by
60	.25/20 HP	.290	2400	12 0	1870		Her.
"	"	"	"	15 0	2240	15,300	"
"	"	"	"	17.0	2500	21,500	"
"	"	"	"	18.4	2665	26,000	"
"	"	"	"	20.1	2880	32,000	"
"	"	"	Unique	7.0	1720		"
"	"	"	"	9.9	2160	26,000	"
"	"	"	HiVel 2	15.0	1570		"
"	"	"	"	21.0	2260		"
"	"	"	"	26.0	2840	32,000	"
"	"	"	HiVel 3	15.0	1880		"
"	"	"	"	20.0	2510	21,500	"
"	"	"	"	23.6	2960	32,000	"
"	"	"	"	26.7	3400	42,000[1]	JBS
"	"	.250	1204	17.0	2115		Du P.
"	"	"	"	22.5	2760		"
"	"	"	3031	26 0	2500		"
"	"	"	"	31 0	2940		"
"	"	"	17½	27.5	2550		"
"	"	"	"	30.6	2910		"
"	"	.290	Sharpshooter	14.0	2305	16,900	Her.
"	"	"	"	16.9	2675	26,000	"
"	"	"	Lightning	12.0	1520		"
"	"	"	"	18.0	2220	16,600	"
"	"	"	"	23.0	2790	32 000	"
"	Lead	.233	Unique	6.5	1790	12,900	"
86	.25/20 SP	.444	2400	9.0	1320		"
"	"	"	"	11.5	1730	15,400	"
"	"	"	"	13.0	1930	20,900	"
"	"	"	"	14.3	2080	26,000	"
"	"	"	"	15.6	2218	32,000	"
"	"	"	Her. 300	28.5	2637[2]	36,000	"
"	"	"	Lightning	20.0	2400	31,000	"
"	Lead	.423	Unique	7.0	1660	16,500	"
87	HP	.295	HiVel 2	15.0	1500		"
"	"	"	"	20.0	2000	20,000	"
"	"	"	"	24.5	2450	32,000	"
"	"	"	HiVel 3	15.0	1770		"
"	"	"	"	19.0	2230	23,700	"
"	"	"	"	21.9	2565	32,000	"
"	"	"	2400	12.0	1720	15,500	"
"	"	"	"	14.0	1955	21,300	"
"	"	"	"	15.2	2095	26,000	"
"	"	"	"	16.5	2240	32,000	"
"	"	"	Unique	6.0	1190	12,500	"
"	"	"	"	9.0	1780	26,000	"
"	"	"	Her. 300	24.2	2686[2]	31,000	"
"	"	"	Lightning	21 0	2528[2]	30,500	"
"	"	.300	1204	15.0	1865		Du P.
"	"	"	"	19.5	2350		"
"	"	"	3031	25 0	2310		"
"	"	"	"	30.0	2795		"
"	"	"	17½	21.5	1850		"
"	"	"	"	30.2	2650		"
"	"	"	18	25.0	2280[2]		"
"	"	"	"	29.4	2650[2]		"
"	"	"	SR 80	10.0	1520		"
"	"	"	"	13.5	1945		"
"	"	.195	Sharpshooter	12.0	1825	17,500	Her.
"	"	"	"	14.8	2155	26,000	"
"	"	"	Lightning	10 0	1260		"
"	"	"	"	16.0	1870	17,700	"
"	"	"	"	21.4	2415	32,000	"
"	"	.30	4320	27.0	2370		Du P.
"	"	"	"	32.0	2730		"
"	"	"	4198	19.0	2260		"
"	"	"	"	21.5	2560		"
88	Lead	.325	SR 80	8.0	1375		"
88	Lead	.325	GR 75	4.3	1110		Du P.
"	"	"	"	5.0	1170		"
"	"	"	"	6.3	1385		"
"	"	"	"	7.0	1420		"
90	"	.400	SR 80	5.5	1075		"
"	"	"	"	9 5	1540		"
100	.250/3000MC	.320	2400	9.0	1300	16,500	Her
"	"	"	"	10.0	1410		"
"	"	"	"	13.0	1750	24,600	"
"	"	"	"	13 5	1800	26.000	"
"	"	"	"	15.3	2000	32,000	"
"	"	"	HiVel 2	16.0	1635		"
"	"	"	"	20 0	2020	24,100	"
"	"	"	"	22 9	2290	32,000	"
"	"	"	HiVel 3	12 0	1500		"
"	"	"	"	16 0	1900	23,000	"
"	"	"	"	19 3	2240	32,000	"
"	"	"	Unique	7.0	1195	20,000	"
"	"	"	"	8.6	1530	26,000	"
"	"	.330	3031	23.0	2060		Du P.
"	"	"	"	27 0	2450		"
"	"	"	17½	28 6	2450		"
"	"	.350	18	22 0	2030		"
"	"	"	"	27.0	2400		"
"	"	.320	Sharpshooter	10.0	1515	19,800	Her.
"	"	"	"	13.4	1820	26,000	"
"	"	"	Lightning	12.0	1380		"
"	"	"	"	16.0	1800	22,000	"
"	"	"	"	19.8	2200	32,000	"
"	"	.35	4320	24.0	2100		Du P.
"	"	"	"	29 0	2465		"
"	"	"	4198	18.0	2110		"
"	"	"	"	21.0	2365		"
111	GC	.431	2400	7 0	1160		Her.
"	"	"	"	10.0	1530	15,200	"
"	"	"	"	11.0	1650	18,200	"
"	"	"	"	13.4	1920	26,000	"
"	"	"	"	14.8	2045	32,000	"
"	"	"	HiVel 2	10.0	1120	8,700	"
"	"	"	"	18.0	1880	20 700	"
"	"	"	"	22.0	2240	32,000	"
"	"	"	HiVel 3	8.0	1100		"
"	"	"	"	15.0	1860	18 700	"
"	"	"	"	19.5	2280	32,000	"
"	"	.500	SR 80	9.3	1425		Du P.
"	"	.431	Unique	5.0	1170	13.000	Her.
"	"	"	"	8.3	1630	26.000	"
"	"	"	GR 75	8.0	1425		Du P.
"	"	"	"	8.5	1465		"
"	"	"	Lightning	8.0	1060		Her.
"	"	"	"	15 0	1810	20 000	"
"	"	"	"	19.5	2210	32,000	"
"	"	"	Sharpshooter	11.0	1735	18,300	"
"	"	"	"	13.6	2030	26,000	"
115	GC	.550	SR 80	13.6	1788		Du P.
117	S[illegible]	.455	2400	10.0	1250		Her.
"	"	"	"	11.0	1400	15 600	"
"	"	"	"	13.0	1620	23 500	"
"	"	"	"	13.6	1685	26.000	"
"	"	"	"	15.0	1840	32.000	"
"	"	.498	HiVel 2	12.0	1200		"
"	"	"	"	18.0	1740	24.000	"
"	"	"	"	22.1	2100	32 000	"
"	"	"	HiVel 3	9.0	1110		"
"	"	"	"	14.0	1600	22 400	"
"	"	"	"	18 6	2050	32 000	"
"	"	"	Unique	7 0	1000		"
"	"	"	"	8.0	1150	26.000	"
"	"	"	Lightning	18.0	2000[1]	30,000	"
"	"	"	Her. 300	26.4	2300[1]	31,000	"
"	"	"	Her. 308	22.0	2000[1]		"
"	"	.425	18	20.0	1725[1]		Du P.
"	"	"	"	23 5	2000[1]		"
"	"	"	"	25.8	2270[1]		"
"	"	"	3031	21 0	1930		"
"	"	"	"	26 5	2350		"
"	"	.550	17½	23.2	1978		"
"	"	"	"	26.0	2250		"
"	"	"	1204	12 5	1410		"
"	"	"	"	18.0	1975		"
"	"	"	SR 80	13.0	1600		"
"	"	.498	Lightning	19.1	2100	33,000	Her.
"	"	"	Sharpshooter	8.0	1220	19,000	"
"	"	"	"	12 5	1640	26,000	"
"	"	"	Lightning	9.0	1020		"
"	"	"	"	14 0	1500	22,000	"
"	"	"	"	18 7	1960	32,000	"
"	"	.425	4320	23.0	1950		Du P.
"	"	"	"	28.0	2295		"
"	"	"	4198	17 0	1930		"
"	"	"	"	20.5	2210		"

[1] Niedner S.S. rifle.

[2] Corrosive primer load.

.25/36 MARLIN

This cartridge is very similar to the .25/35 Winchester, and, generally speaking, any of the loads for the Winchester can be used with reasonable success in the Marlin cartridge. It is now an obsolete number, although it used identically the same type and weights of bullets as .25/35 Winchester. This cartridge was designed by William V. Lowe as the ".25/37." Marlin adopted it around 1897 but chose to call it the .25/36. Winchester followed shortly thereafter with their version known as the .25/35 WCF. Both cartridges can utilize the same bullets.

.25/36 Marlin

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt Chg. Grs.	M V in 26-in. Barrel	Breech Pressure	Recommended by
86	SP	.400	17½	20.0	1815		Du P.
"	"	"	"	26.0	2375		"
"	"	"	18	23.0	2275[1]		"
"	"	"	"	28.0	2570[1]		"
"	"	"	3031	21.0	2030		"
"	"	"	"	28.0	2580		"
87	Hi-Speed	.300	"	21.0	2030		"
"	"	"	"	28.0	2585		"
88	Lead	.350	SR 80	8.0	1360		"
"	"	"	GR 75	6.5	1400[1]		"
111	"	.500	SR 80	9.0	1415		"
"	"	"	GR 75	8.0	1375[1]		"
"	"	"	Unique	7.0	1450[2]		Her.
115	GC	.550	SR 80	14.0	1790		Du P.
"	"	"	GR 75	14.0	1700[1]		"
117	SP	.455	Her. 300	22.6	1865[1]	28,000	Her.
"	"	"	Her. 308	21.5	1850[1]		"
"	"	"	Lightning	16.5	2100[1]	32,000	Her.
"	"	.550	3031	19.0	1730		Du P.
"	"	"	"	23.5	2105		"
"	"	.450	17½	20.8	1866		"
"	"	"	"	25.5	2275		"
"	"	"	18	19.0	1605[1]		"
"	"	"	"	26.0	2275[1]		"
"	"	"	16	20.0	1866[1]		"
"	"	"	"	24.5	2275[1]		"
"	"	"	21	19.0	1855[1]		"
"	"	"	SR 80	13.0	1600		"
"	"	.550	4198	15.5	1680		"
"	"	"	"	19.5	2055		"

[1] Corrosive primer load.
[2] Extra-strong rifles only.

.25 REMINGTON

The .25 Remington is the rimless version of the .25/35 Winchester. It is designed for the Remington series of slide-action rifles as well as their autoloading type, although it is used in addition in the Model 30 bolt action. Rifles made to handle this cartridge by Remington had a twist of 1 turn in 8 inches; as made by Stevens, 1 turn in 8 inches. With standard bullets, this can be loaded to make a good medium-power cartridge suitable for deer under short-range conditions. With a light-weight bullet and a solid frame gun, it makes an extremely excellent varmint weapon and is in great demand for this purpose. Excellent accuracy can be obtained with some of the high-velocity loading.

.25 Remington

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt Chg. Grs.	M V in 22-in. Barrel	Breech Pressure	Recommended by
60	.25/20 MC	.285	2400	12.0	1940		Her.
"	"	"	"	15.0	2315	20,000	"
"	"	"	"	19.0	2800	34,000	"
"	"	"	"	20.9	3040	42,000	"
"	"	"	HiVel 2	18.0	1850		"
"	"	"	"	23.0	2340	19,000	"
"	"	"	"	31.8	3220	42,000	"
"	"	"	HiVel 3	16.0	1990		"
"	"	"	"	21.0	2545	19,000	"
"	"	"	"	28.5	3390	42,000	"
"	"	"	"	30.0	3500[1]	Max.[1]	JBS
"	"	"	Unique	9.0	2020	19,300	Her.
"	"	"	"	12.9	2565	34,000	"
"	"	.250	3031	28.0	2615		Du P.
"	"	"	"	34.5	3110		"
"	"	"	17½	32.5	2775		"
"	"	"	"	35.5	3110		"
"	"	"	SR 80	11.3	1850		"
"	"	"	"	15.0	2260		"
"	"	"	1204	18.5	2250		"
"	"	"	"	23.5	2720		"
"	"	.285	Lightning	18.0	2140		Her.
"	"	"	"	23.0	2660	25,000	"
"	"	"	"	28.3	3220	42,000	"
"	"	"	Sharpshooter	15.0	2370	19,000	"
"	"	"	"	20.6	3020	34,000	"
"	Lead	.200	1204	15.0	1725		Du P.
"	"	.229	Unique	6.0	1574	10,900	Her.
86	"	.267	"	5.0	1245	9,700	"
"	"	"	SR 80	9.0	1350		Du P.
87	.25/35 SP	.297	2400	10.0	1530		Her.
"	"	"	"	13.0	1840	18,000	"
"	"	"	"	14.0	1940	20,100	"
"	"	"	"	18.0	2345	34,000	"
"	"	"	"	19.4	2490	42,000	"
"	"	"	HiVel 2	14.0	1360		"
"	"	"	"	21.0	2010	19,500	"
"	"	"	"	30.3	2870	42,000	"
"	"	"	"	33.0	2990	Max.[1]	JBS
"	"	"	HiVel 3	15.0	1770		Her.
"	"	"	"	19.0	2160	20,000	"
"	"	"	"	26.6	2900	42,000	"
"	"	"	Her. 300	27.0	2700[2]	31,300	"
"	"	"	Lightning	24.6	2605[1]	32,000	"
"	"	"	Unique	12.0	2080[2]		"
"	"	.300	3031	26.0	2425		Du P.
"	"	"	"	31.5	2755		"
"	"	"	1147	33.0	2850	Max.[1]	JBS
"	"	"	17½	30.0	2500		Du P.
"	"	"	"	34.0	2820		"
"	"	"	18	28.0	2370[2]		"
"	"	"	"	32.0	2755[1]		"
"	"	"	1204	17.0	1965		"
"	"	"	"	24.5	2575		"
"	"	"	SR 80	12.0	1630		"
"	"	"	"	15.5	2020		"
"	"	.297	Lightning	19.7	2100	19,000	Her.
"	250/3000 SP	"	Her. 300	31.5	2624[2]	34,000	"
"	.25/35 SP	"	Sharpshooter	21.9	2618[2]	34,000	"
"	"	"	4064	34.0	2900[1]	Max.[1]	JBS
"	"	.30	4198	20.0	2325		Du P.
"	"	"	"	23.5	2580		"
90	Lead	.400	SR 80	6.0	1120		"
"	"	"	"	10.0	1520		"
100	.250/3000 HP	.357	2400	10.0	1245		Her.
"	"	"	"	13.0	1675	19,600	"
"	"	"	"	14.0	1800	23,200	"
"	"	"	"	16.8	2100	34,000	"
"	"	"	"	18.7	2255	42,000	"
"	"	"	HiVel 2	12.0	1270		"
"	"	"	"	18.0	1780	20,600	"
"	"	"	"	28.1	2630	42,000	"
"	"	"	HiVel 3	10.0	1250		"
"	"	"	"	16.0	1820	21,600	"
"	"	"	"	24.0	2590	42,000	"
"	"	.475	17½	27.0	2396		Du P.
"	"	"	"	31.2	2650		"
"	"	"	18	31.0	2405[2]		"
"	"	"	SR 80	9.5	1325		"
"	"	"	"	13.0	1800		"
"	"	"	21	24.5	2330[2]		"
"	"	"	16	26.0	2396[2]		"
"	"	"	"	30.0	2650[2]		"
"	"	.357	4064	30.0	2550[1]	Max.[1]	JBS
101	MC	"	18	27.1	2350		Du P.
"	"	"	"	30.5	2600[2]		"
111	GC	.431	Unique	6.0	1430	17,600	Her.
"	"	"	"	9.9	1860	20,000	"
"	"	"	2400	9.0	1550		"
"	"	"	"	11.0	1705	20,000	"
"	"	"	"	12.0	1777	22,600	"

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 22-in. Barrel	Breech Pressure	Recommended by
111	GC	.431	2400	16.0	2080	34,000	Her.
"	"	"	"	18.7	2280	42,000	"
"	"	"	HiVel 2	8.0	1100		"
"	"	"	"	18.0	1840	20,100	"
"	"	"	"	28.7	2620	42,[redacted]	"
"	"	"	HiVel 3	6.0	960		"
"	"	"	"	15.0	1865	20,300	"
"	"	"	"	24.2	2520	42,000	"
"	"	"	Lightning	6.0	970		"
"	"	"	"	14.0	1700	19,000	"
"	"	"	"	24.0	2440	42,000	"
"	"	"	Sharpshooter	11.0	1730	19,900	"
"	"	"	"	16.3	2180	34,000	"
112	"	.500	SR 80	14.5	1825		Du P.
"	"	"	GR 75	14.0	1770[3]		"
117	MC	.505	Unique	7.0	970	18,500	Her.
"	"	"	"	10.6	1575	34,000	"
"	"	"	2[redacted]	12.0	1420		"
"	"	"	"	13.0	1540	19,000	"
"	"	"	"	15.0	1750	25,800	"
"	"	"	"	16.8	1935	34,000	"
"	"	"	"	18.3	2085	42,000	"
"	"	"	HiVel 2	10.0	1010		"
"	"	"	"	16.0	1525	20,300	"
"	"	"	"	26.4	2420	42,000	"
"	"	"	HiVel 3	8.0	1020		"
"	"	"	"	14.0	1560	20,700	"
"	"	"	"	23.5	2430	42,000	"
"	"	"	Her. 300	30.0	2425[2]	37,900	"
"	"	"	Her. 308	24.0	2000[3]		"
"	"	"	Sharpshooter	17.8	2100[3]	34,000	"
"	"	.450	3031	21.5	1900		Du P.
"	"	"	"	26.0	2225		"
"	"	"	17½	25.7	2128		"
"	"	"	"	29.1	2350		"
"	"	"	"	31.2	2534		"
"	"	"	1204	20.0	1960		"
"	"	"	"	22.7	2140		"
"	"	"	SR 80	10.0	1240		"
"	"	"	"	14.0	1775		"
"	"	"	18	23.0	1950[3]		"
"	"	"	"	27.5	2340[3]		"
"	"	.505	Sharpshooter	11.0	1440	21,000	Her.
"	"	"	"	15.6	1905	34,000	"
"	"	"	"	17.8	2100[3]	38,000	"
"	"	"	Lightning	12.0	1290		"
"	"	"	"	16.0	1660	23,100	"
"	"	"	"	20.8	2105[3]	32,300	"
"	"	"	"	23.2	2310	42,000	"
"	"	.45	4064	28.5	2400[1]	Max.[2]	JBS
"	"	"	4198	17.0	1800		Du P.
"	"	"	"	22.0	2215		"

[1] Estimated velocity.
[2] Maximum for bolt actions only.
[3] Corrosive primer load.

.250/3000 SAVAGE

This particular cartridge was also a development of the late Charles Newton. As designed by Mr. Newton in the early 1900's, however, the bullet was to weigh 100 grains and to be driven at a velocity of approximately 2800. As late as 1932 he told me that he considered it a grave mistake of the Savage firm to have brought this out with an 87-grain bullet and insisted that some day the cartridge would be properly revised by ammunition manufacturers to use his original weight of 100 grains. Unfortunately, Mr. Newton did not live to see the development. He died early in 1933, I believe, and during that summer the Peters Cartridge Company sprung the first release with this particular bullet driven at a velocity of 2800. Later all other ammunition manufacturers released a 100-grain bullet, but loaded somewhat under the Peters figure, the average of the other loads being around 2700. Mr. Newton always insisted that the 100-grain was the ideal weight for finest accuracy and greatest killing power in this cartridge. When he sold his ideas to the Savage Arms Company, they altered the bullet to weigh 87 grains because they wanted a 3000-foot velocity—the highest commercial velocity at that time—to use as a talking point, and the only way they could achieve that velocity with then existing powders was by reduction of bullet weight. Originally designed with a 12-inch twist, this has been increased to a 10-inch twist by some manufacturers. The 10-inch twist gives far greater accuracy with all bullets. It can be loaded with light and heavy loads, and has a working pressure of around 40,000 pounds in lever-action, and 50,000 pounds in bolt-action arms. The bottleneck resizes well and stands up excellently in spite of the sharp neck. It was introduced in 1914.

.250/3000 Savage

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 22-in. Barrel	Breech Pressure	Recommended by
60	.23/20 HP	.289	2400	14.0	2205		Her.
"	"	"	"	16.0	2430	20,000	"
"	"	"	"	19.0	2770	30,000	"
"	"	"	"	20.7	2960	36,000	"
"	"	"	"	22.3	3145	42,000	"
"	"	"	HiVel 2	18.0	1900		"
"	"	"	"	26.0	2650	22,500	"
"	"	"	"	33.6	3360	42,000	"
"	"	"	"	35.0	3500	Max.	JBS
"	"	"	HiVel 3	18.0	2240		Her.
"	"	"	"	24.0	2890	25,500	"
"	"	"	"	28.8	3410	42,000	"
"	"	"	"	29.0	3450	43,000	HAD
"	"	"	Unique	10.0	2205	19,600	Her.
"	"	"	"	14.0	2695	36,000	"
"	"	"	Lightning	20.0	2464		"
"	"	"	"	25.0	2920	29,300	"
"	"	"	"	28.8	3260	42,000	"
"	"	.250	3031	30.0	2665		Du P.
"	"	"	"	38.0	3275		"
"	"	"	17½	28.0	2475		"
"	"	"	"	39.0	3200		"
"	"	"	"	40.0	3400		"
"	"	"	SR 80	12.0	1760		"
"	"	"	"	18.7	2520		"
"	"	.289	Sharpshooter	17.0	2620	20,200	Her.
"	"	"	"	22.0	3155	36,000	"
"	Lead	.470	Unique	10.0	2091	20,100	"
"	"	"	SR 80	4.5	950		Du P.
"	"	"	"	11.7	1700		"
61	Lead "Bond"	.200	"	4.5	955		"
"	"	"	"	5.7	1080[1]		HGL
"	"	"	"	11.7	1725		Du P
65	GC	"	Du P. 5	4.4			HGL
74	"	"	Unique	6.0			HAD
"	"	"	HiVel 3	12.0	1600		"
80	"	.307	2400	12.0	1760		Her.
"	"	"	"	17.0	2300	20,500	"
"	"	"	"	20.8	2705	36,000	"
"	"	"	"	21.9	2830	42,000	"
"	"	"	HiVel 2	13.0	1400		"
"	"	"	"	24.0	2330	20,700	"
"	"	"	"	31.5	2970	42,000	"
"	"	"	HiVel 3	13.0	1640		"
"	"	"	"	23.0	2540	26,600	"
"	"	"	"	28.0	3000	42,000	"
"	"	"	Unique	7.0	1550		"
"	"	"	"	9.0	1840	19,000	"
"	"	"	"	10.0	1965	22,500	"
"	"	"	"	13.5	2340	36,000	"
"	"	"	"	14.8	2470	42,000	"

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 22-in. Barrel	Breech Pressure	Recommended by
80	GC	.307	Lightning	13.0	1705		Her.
"	"	"	"	23.0	2530	28,000	"
"	"	"	"	27.6	2910	42,000	"
"	"	"	Sharpshooter	12.0	1910		"
"	"	"	"	15.0	2175	19,100	"
"	"	"	"	17.0	2355	24,500	"
"	"	"	"	20.7	2685	36,000	"
"	"	"	"	22.5	2845	42,000	"
"	"	.250	SR 80	19.5	2300		Du P.
"	"	"	"	17.0			HGL
"	Cast	.300	Unique	6.8	1560	12,700	Her.
85	GC	"	SR 80	11.5			HGL
"	"	"	Lightning	16.5			Her.
"	"	"	Sharpshooter	13.0			"
86	Lead	.425	SR 80	5.5	1050		Du P.
"	"	"	"	12.0	1710		"
"	"	"	"	14.0	1810		"
"	"	"	Unique	8.5	1770	16,000	Her.
87	HP	.233	2400	11.0	1710		"
"	"	"	"	12.0	1800	20,000	"
"	"	"	"	16.4	2200	27,500	"
"	"	"	"	19.0	2440	36,000	"
"	"	"	"	20.5	2565	42,000	"
"	"	"	HiVel 2	13.0	1240		"
"	"	"	"	26.0	2380	26,200	"
"	"	"	"	33.0	2995	42,000	"
"	"	"	"	35.5	3150	51,000[2]	HAD
"	"	"	HiVel 3	13.0	1595		Her.
"	"	"	"	23.0	2500	27,800	"
"	"	"	"	27.6	2925	42,000	"
"	"	"	"	28.0	3000	43,000	HAD
"	"	"	Her. 300	37.5	3055[1]	45,700	Her.
"	"	"	Sharpshooter	27.1	2930[3]	48,200	"
"	"	"	Lightning	29.9	3000[3]	44,000	"
"	"	.225	3031	29.0	2600		Du P.
"	Hi-Speed	"	"	30.0	2670		"
"	"	"	"	36.5	3110		"
"	SP	.233	"	38.0	3700	Max.	JBS
"	"	.400	18	30.0	2440[3]		Du P.
"	"	"	"	36.5	2980[3]		"
"	"	"	"	39.5	3200[3]	Max.	"
"	"	"	16	35.7	3000[3]		"
"	"	"	"	39.0	3250[3]		"
"	"	"	21	30.5	3000[3]		"
"	"	"	15½	40.4	3000		"
"	"	"	SR 80	12.0	1600		"
"	"	"	"	18.0	2100		"
"	HP	.233	17½	33.0	2620		"
"	"	"	"	40.6	3200		"
"	"	"	1204	23.0	2360		"
"	"	"	"	28.0	2815		"
"	"	"	Unique	10.0	1714	25,000	Her.
"	"	.20	4320	32.0	2535		Du P.
"	"	"	"	38.0	3030		"
"	"	"	4064	32.0	2600		"
"	"	"	"	38.0	3095		"
"	"	"	4198	24.0	2500		"
"	"	"	"	29.5	2970		"
90	GC	"	HiVel 3	14.0	1700		HAD
"	Lead BT	.400	SR 80	7.0	1185		Du P.
"	"	"	"	11.0	1575		"
93	Lead	.275	"	5.0	1030		"
"	"	"	"	11.5	1675		"
100	HP	.288	2400	9.0	1260		Her.
"	"	"	"	12.0	1540	20,500	"
"	"	"	"	15.0	1835	26,800	"
"	"	"	"	18.4	2160	36,000	"
"	"	"	"	19.8	2295	42,000	"
"	"	"	HiVel 2	13.0	1310		"
"	"	"	"	23.0	2130	26,500	"
"	"	"	"	29.4	2670	42,000	"
"	"	"	"	33.0	2860[3]	49,860[2]	"
"	"	"	"	34.5	2900	52,000[2]	JBS
"	"	"	HiVel 3	10.0	1235		Her.
"	"	"	"	20.0	2160	27,200	"
"	"	"	"	24.8	2600	42,000	"
"	"	"	Unique	6.0	750		"
"	"	"	"	8.0	1220	19,500	"
"	"	"	"	10.0	1540	26,000	"
"	"	"	"	12.6	1835	36,000	"
"	"	"	"	13.9	1950	42,000	"
"	"	"	Lightning	10.0	1050		"
"	"	"	"	20.0	2010	26,600	"
"	"	"	"	26.0	2590	42,000	"
"	"	"	Sharpshooter	9.0	1300		"
"	"	"	"	11.0	1500	17,300	"
"	"	"	"	15.0	1900	27,000	"
"	"	"	"	18.2	2225	36,000	"

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 22-in. Barrel	Breech Pressure	Recommended by
100	HP	.288	Sharpshooter	19.9	2400	42,000	Her.
"	"	"	Her. 300	35.6	2794[1]	50,110[1]	"
"	"	.350	3031	28.0	2420		Du P.
"	"	"	"	34.0	2830		"
"	HP	.300	1204	21.0	2110		"
"	"	"	"	26.0	2525		"
"	"	"	17½	30.0	2415		"
"	"	"	"	35.4	2875		"
"	"	"	15½	37.4	2740		"
"	"	"	"	39.4	2980		"
"	"	"	16	34.0	2673[1]		"
"	"	"	"	35.0	3035[1]		"
"	"	"	SR 80	18.0	1900		"
"	"	.35	4320	30.0	2425		"
"	"	"	"	36.0	2820		"
"	"	"	4064	30.0	2360		"
"	"	"	"	36.5	2885		"
"	"	"	4198	23.0	2300		"
"	"	"	"	28.5	2720		"
104	"	.300	SR 80	12.0	1500		"
115	WTCW	.400	15½	33.5	2375		"
"	"	"	"	38.0	2730		"
"	"	"	SR 80	10.2	1110		"
"	"	"	"	14.2	1570		"
117	.25/35 SP	.519	2400	10.0	1150		Her.
"	"	"	"	11.0	1240	20,200	"
"	"	"	"	14.0	1540	26,800	"
"	"	"	"	17.2	1860	36,000	"
"	"	"	"	19.1	2040	42,000	"
"	"	"	HiVel 2	13.0	1200		"
"	"	"	"	22.0	1935	16,400	"
"	"	"	"	28.2	2450	42,000	"
"	"	"	HiVel 3	10.0	1190		"
"	"	"	"	18.0	1860	26,000	"
"	"	"	"	24.0	2360	42,000	"
"	"	"	Unique	8.0	960	21,500	"
"	"	"	"	10.0	1310	28,300	"
"	"	"	"	12.0	1560	36,000	"
"	"	"	"	13.4	1700	42,000	"
"	"	"	Lightning	12.0	1225		"
"	"	"	"	19.0	1840	26,500	"
"	"	"	"	24.8	2350	42,000	"
"	"	"	Sharpshooter	9.0	1290	20,600	"
"	"	"	"	10.0	1380	21,000	"
"	"	"	"	14.0	1730	27,100	"
"	"	"	"	17.1	2000	36,000	"
"	"	"	"	18.8	2150	42,000	"
"	"	.425	3031	28.0	2465		Du P.
"	"	"	"	34.0	2650	Max.	"
"	"	"	17½	31.0	2400		"
"	"	"	"	34.5	2630	Max.	"
"	"	"	15½	35.4	2510		"
"	"	"	"	37.4	2680	Max.	"
"	"	"	18	35.0	2640[3]	Max.	"

[1] Estimated velocity.
[2] Extra-strong rifles only.
[3] Corrosive primer load.

.25 KRAG

The .25 Krag cartridge was designed by a number of different shooters away back in the early 1900's. It was first used by Dr. Mann, A. O. Niedner, Charles Newton, and many others. Essentially, this is the regular .30/40 Krag cartridge necked down. Loading data on it are based on the standard cartridge case developed by Niedner. The cartridge has long been extremely popular and is capable of the finest accuracy with proper loading. It will handle any of the .25 caliber bullets, the average barrel diameter being about .257. The cartridge cases are of course all hand formed and can be obtained from the maker of the rifle. I believe that Griffin & Howe also chamber for this cartridge, and can supply the shells.

.25 Krag

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 26-in. Barrel	Breech Pressure	Recommended by
60	HP Win.	2⅝[1]	1204	27.0	3000		HAD
"	"	"	H.Vel 3	24.0	2900	25,500	"
"	"	"	"	29.0	3450		"
86	25/20 MC	"	17½	39.5	3100		"
"	"	"	Pyro	45.0			R
"	"	"	4064	40.0	3200		JBS
"	"	"	3031	40.0	Fast		"
"	"	"	SR 80	12.5	1400[2]		"
"	"	"	Du P. Shotgun	13.0	1350[2]		"
"	"	"	Her 300	37.5	3100		"
87	HP Rem.	2 11/16[1]	17½	37.0	3000		HAD
"	"	"	1147	42.0	3100		"
"	"	"	3031	40.0	Fast		JBS
"	"	"	HiVel 3	28.0	3000		HAD
"	"	"	HiVel 2	34.0	3000		"
"	"	"	"	36.0			"
"	"	"	1147	46.0			R
"	"	"	4064	35.0	2800[2]		HAD
"	"	"	"	36.0	2850[2]		"
"	"	"	"	37.0	2900[2]		"
"	"	"	"	38.0	2950[2]		"
"	"	"	"	40.0	3200[2]	Mild	JBS
90	GC Loverin	2¼[1]	SR 80	18.0	2100		HAD
"	"	"	2400	16.0	2100		"
"	"	"	HiVel 3	20.0	2100		"
"	"	"	Schuetzen	14.0	1600		"
100	HP	2 11/16[1]	Pyro	34.0	2600		"
"	"	"	"	41.0			R
"	"	"	15½	41.0			"
"	"	"	"	42.0	3000		HAD
"	"	"	1147	40.0			R
"	"	"	"	41.0			"
"	"	"	17½	32.0	2500		"
"	"	"	"	36.0		Max.	"

[1] Overall length.
[2] Estimated velocity.

.25/06 NIEDNER

The .25/06 Niedner is by no means a new cartridge. The writer first saw it in the early 1920's on a custom job built by A. O. Niedner for a friend. Essentially it is the regular .30/06 cartridge necked down to .25 caliber with approximately the same shoulder taper. It shoots reasonably well, but, because of the large capacity of the cartridge case, is not as satisfactory as the .25 Krag or the .257 Roberts. Griffin & Howe also chambered for this cartridge and can supply the shells. Properly loaded, it has excellent possibilities from the standpoint of accuracy and is widely used as a woodchuck cartridge by men who demand excellent accuracy. Although the author has shot it very little, he has seen others make inch-and-a-quarter groups at 100 yards and do this consistently for several strings.

.25/06 Niedner

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
86	.25/20 MC	3.16[1]	Du P. Shotgun	13.5	1350		HL
"	"	"	SR 80	13.4	1550[2]		"
"	"	"	"	15.0	1700		"
87	"	"	1147	47.0	3200	Max.	"
"	"	"	Her 300	45.5	3180		"
"	"	"	17½	42.5	3160		"
100	Roberts		4064	40.0		Low	JBS
"	"		"	46.0		High	"
"	"		1147	43.5	3050	Max.	"
"	"	3.085[1]	17½	39.0	2880	Max.	"
"	"	"	Her 300	43.0	3000	Max.	"
117	MC	"	1147	38.0	2700		"
"	"	"	"	42.0	2900	Max.	"
"	"	"	18	32.0			HL
"	"	"	Pyro	38.5			"
"	"	"	17½	40.0			"

[1] Overall length.
[2] Estimated velocity.

.25 G. & H. AND NIEDNER ROBERTS

The .25 Griffin & Howe and Niedner-Roberts cartridge is the one originally known as the .25 Roberts. Throughout this book, however, it is being designated under the above full name, as it is entirely different from the .257 Roberts cartridge sold commercially. The .25 Roberts cartridge was never manufactured by any firm and was the original Roberts development designed by Ned H. Roberts of Berlin, N. H. Major Roberts began experimenting with the .25 caliber back around 1909, cooperating with Dr. Mann and A. O. Niedner. Since that time he has been playing with it continuously and has had countless different barrels and bullets and cases made to his specifications.

.25 G. & H. and Niedner-Roberts

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	Ins. V. 24-in. Barrel	Pressure	Recommended by
77	Ideal		SR 80	10.0			NHR
"	"		"	12.0			"
80	Ideal 1-10		"	14.0			"
86	"		"	8.0			"
87	MC	.125	Her.300	42.0	3138	50 000	"
"	"	"	"	44.0	3302	53.000	"
"	"	"	17½	43.5	3310	48.000	"
"	"	"	15½	44.0	3095	48,000	"
"	"	"	"	43.0			R
"	"	"	"	44.5			"
"	"	"	16	44.0			"
"	"	"	Lot 1637 1185	42.0	3021	48 000	NHR
"	"	"	Lot 67 1185	44.0	3004	52 000	"
"	"	"	"	46.0	3158	55,000	"
"	"	"	Lot 540 Pyro	40.0	2789	48 000	"
"	"	"	"	42.5	2989	50 000	"
"	"	"	20	40.0	2790[2]	48 000	"
"	"	"	"	42.5	2890[2]	50.000	"
"	"	"	1147	43.5	3055	48.000	"
"	"	"	"	44.0			R
"	"	"	"	45.0	3113	50,000	NHR
"	"	"	3031	42.0	3450[2]	49,000	"
"	"	"	4064	43.0			JBS
"	"	"	"	45.0		Max.	"
99	USMC[3]	.1875	1185	38.0	2637	45 000	NHR
100	West OP	"	15½	38.0			R
"	"	"	"	41.0			"
"	"	"	"	42.0	2946	48.000	NHR
"	"	"	Her 300	37.0	2814	46,000	"
"	"	"	"	40.0			R
"	"	"	"	41.5	3007	48.000	NHR
"	"	"	1147	28.5	2000	40 000	"
"	"	"	"	37.0	2610	46 000	"
"	"	"	"	42.0	2964	48,000	"
"	"	"	Lot 1637 1185	34.0			"
"	"	"	"	36.0			"
"	"	"	"	39.0	2798	46,000	"
"	"	"	"	42.0	2915	48 000	"
"	"	"	17½	26.0			R
"	"	"	"	30.0	1975		"

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	Ins. V[1] 24-in. Barrel	Pressure	Recommended by
100	West OP	1875	17½	36.0			R
"	WTCW	"	Pyro	41.0			NHR
"	"	"	20	41.0			"
"	"	"	16	39.6			"
"	"	"	Her.300	37.0	2814		"
"	"	"	"	40.0			"
"	"	"	1204	21.0	1975		"
"	"	"	1147	28.5	1965	40,000	"
"	"	"	"	36.0			"
"	"	"	4064	41.0			JBS
"	USSP	"	1147	28.5	1915	40,000	NHR
"	"	"	"	41.5	2775	48,000	"
"	"	"	15½	41.5	2763	48,000	"
"	"	"	17½	28.5	2201	40,000	"
"	"	"	"	40.0	2891	48,000	"
101	Rem. Pointed	"	1185	39.0	2861	46,000	"
"	"	"	Her.300	39.5	2925	49,000	"
117	BT OP	.27	Lot 1637 1185	37.5	2662	48,000	NHR
"	"	"	Lot 67 1185	38.0	2643	49,000	"
"	"	"	1147	28.5	1924	40,000	"
"	"	"	"	38.0			R
"	"	"	"	42.0[4]	2882	53,000	NHR
"	"	"	15½	37.5	2583	48,000	"
"	"	"	"	38.0			R
"	"	"	"	39.0	2695	49,000	NHR
"	"	"	16	36.0			R
"	"	"	"	36.6	2700[2]	48,000	NHR
"	"	"	17½	28.5	2126	40,000	"
"	"	"	HiVel 2	33.0	2579	47,000	Niedner
"	"	"	3031	35.5	2800[2]	48,000	NHR
"	MC Flat base	.25	Lot 1637 1185	34.0			"
"	"	"	"	38.5	2730	49,000	"
"	"	"	1147	34.0			R
"	"	"	"	38.5	2700	49,000	NHR
"	"	"	16	36.0			R
"	"	"	"	38.5	2800[2]	52,000	NHR
"	"	"	17½	34.0	2500		"
"	"	"	"	36.0	2700	48,000	"
"	"	"	Her.300	36.0			R
"	"	"	"	38.5			R
"	"	"	3031	35.5	2800	48,000	NHR
"	"	"	"	36.5	2900[2]	50,000	"

[1] Instrumental velocity at 53 ft.
[2] Estimated velocity.
[3] U. S. bullet with point cut off.
[4] On a 42-grain charge of #1147 the pressures are too high for a 10-inch twist. This charge was tested in a barrel with a 12-inch twist and is a maximum load.

The original .25 Roberts was the 7 mm. cartridge necked down to .25 caliber but having a long sloping neck. Also, at least two times, the length of the neck was altered slightly so that the Niedner Roberts and the Griffin & Howe Roberts were somewhat different. Since the introduction of the .257 Roberts commercial cartridge, however, both of these custom gun builders have been chambering their rifles for it. More than 600 were made, however, for the old cartridge, and only a few have been sent in for alterations. It should be thoroughly understood that loading data for the .25 Roberts and .257 Roberts *must not* be interchanged. Incidentally, handloaders having folders on Du Pont #3031, #15½, and #17½ with loading data on the ".25 Roberts" should bear in mind that this is an error on the part of Du Pont. The cartridge referred to is not the .25 Roberts, *but the .257.* Most of the loads given for the .257 Roberts can be used in the .25 Roberts, but one can by no means reverse the procedure. Maximum loads in the .25 would create extremely dangerous pressures in the .257 due to the sharper angle or slope of the bottle neck.

(After trying a 60-grain MCHP bullet in this cartridge and in the .257 as well, Major Roberts wrote for both: "No good in this cartridge; accuracy is very poor and velocity actually lower than with 86- and 87-grain bullets. Not recommended except as a waste of good primers and good powder." The figures for other bullet weights are given in the table beginning on page 358.)

.257 REMINGTON & WINCHESTER ROBERTS

This is the commercial cartridge known as the .257 Roberts, for which a great many custom-built rifles are manufactured. The Remingtons chamber their Model 30 S for this, and Winchester has added it to the Model 54 and Model 70 lines. Both firms make the ammunition. As loaded commercially, there are three available bullet weights, 87, 100, and 117. Commercial bullets are a poor shape of hollow point, but despite this awkward shape, deliver excellent accuracy and good ballistics. When I was discussing the bullet shape with Major Roberts, he told me that he had experimented with a great many types of spitzer bullets and was unable to get reasonable accuracy. Incidentally, he demands that his .257 loads show 10 consecutive shots in a one-inch group at 100 yards, not occasionally, but most of the time, wind and weather being favorable. Major Roberts admits, however, that a spitzer bullet would be far more satisfactory if an accurate one could be designed, and several of the ammunition makers are now working on this angle.

The .257 Roberts was originally designed by the Remingtons who were experimenting with the .25 Roberts cartridge in an effort to produce it commercially. The long slender taper of the shoulder, however, did not appeal to them because of its manufacturing complications. Accordingly, they changed the angle entirely so that the .257 cartridge cannot be shot in rifles chambered for the .25 caliber Roberts. It was first produced as the ".25 Roberts," but Captain E. C. Crossman insisted that to release it that way would be to invite severe complications; he suggested the change in name to .257 Roberts, which Remington immediately accepted. In August 1935 Winchester added this to the Model 54 line and began the production of the ammunition. The cartridge case is unusually well manufactured and more sturdy than the average run of cases. It is an excellent number for hand-

.257 Roberts

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
65	Gas-check	.225	Lightning	18.0	2090		Her.
"	"	"	"	25.0	2610	20,800	"
"	"	"	Sharpshooter	16.0	2280		"
"	"	"	"	20.0	2620	20,300	"
"	"	"	2400	16.0	2210		"
"	"	"	"	20.0	2600	23,800	"
"	"	"	Unique	12.0	2215	19,600	"
"	"	"	"	16.2	2620	40,000	"
70	HP	.199	HiVel 2	30.0	2620		"
"	"	"	"	35.0	3040	32,500	"
"	"	"	"	40.0	3500	50,000	"
"	"	"	HiVel 3	25.0	2480		"
"	"	"	"	33.0	3120	33,500	"
"	"	"	"	37.8	3520	50,000	"
"	"	"	Lightning	20.0	2200		"
"	"	"	"	28.0	2850	29,000	"
"	"	"	"	34.4	3340	50,000	"
"	"	"	Sharpshooter	18.0	2420	20,400	"
"	"	"	"	26.4	3145	40,000	"
"	"	"	2400	18.0	2325	20,400	"
"	"	"	"	24.4	2880	40,000	"
"	"	"	Unique	13.0	2130	19,800	"
"	"	"	"	16.5	2540	40,000	"
77	Ideal	"	SR 80	10.0			NHR
"	"	"	"	12.0			"
80	Ideal 1-10	"	"	14.0			"
84	Cast	.353	Unique	10.0	1822	18,600	Her.
86	Ideal 1-10	"	SR 80	8.0			NHR
87	MC	.270	3031	37.0			Roy Evans
"	"	"	"	40.0	3200		Du P.
"	"	"	"	42.0	3350	46,000	Du P.
"	"	.250	"	43.0	3500[1]	50,000[2]	NHR
"	"	"	1147	42.0	3400[1]	47,000[2]	"
"	"	"	4064	42.0		Max.	JBS
"	"	.239	HiVel 2	26.0	2220		Her.
"	"	"	"	33.0	2800	31,000	"
"	"	"	"	39.0	3295	50,000	"
"	"	"	HiVel 3	24.0	2315		"
"	"	"	"	32.0	2940	35,600	"
"	"	"	"	36.8	3320	50,000	"
"	"	"	Lightning	21.0	2165		"
"	"	"	"	29.0	2820	36,000	"
"	"	"	"	33.2	3160	50,000	"
"	"	"	Sharpshooter	16.0	2105	20,000	"
"	"	"	"	24.6	2800	40,000	"
"	"	"	2400	16.0	2025	19,800	"
"	"	"	"	22.9	2600	40,000	"
"	"	"	Unique	11.0	1795	19,300	"
"	"	"	"	16.0	2290	40,000	"
100	MC	.340	3031	36.5	2900		Du P.
"	"	"	"	40.0	3050	46,000	"
"	"	"	"	41.0	3100	48,000	JBS
"	"	"	4064	41.0			"
"	"	"	"	42.5		Max.	"
"	"	.280	1147	40.0	3050[1]	48,000[2]	NHR
"	"	.301	HiVel 2	24.0	2100		Her.
"	"	"	"	32.0	2700	35,800	"
"	"	"	"	37.0	3070	50,000	"
"	"	"	HiVel 3	20.0	1965		"
"	"	"	"	28.0	2560	32,000	"
"	"	"	"	35.0	3080	50,000	"
"	"	"	Lightning	19.0	1950		"
"	"	"	"	26.0	2445	31,400	"
"	"	"	"	31.3	2830	50,000	"
"	"	"	Sharpshooter	14.0	1820	20,700	"
"	"	"	"	23.1	2550	40,000	"
"	"	"	2400	15.0	1790	20,000	"
"	"	"	"	22.6	2410	40,000	"
"	"	"	Unique	10.0	1470	20,000	"
"	"	"	"	15.5	2080	40,000	"
"	Gas-check	.306	Lightning	20.0	2025	16,800	"
"	"	"	"	24.0	2237	23,500	"
"	"	"	Sharpshooter	16.0	1985	18,800	"
"	"	"	"	21.0	2330	31,200	"
"	"	"	2400	16.0	1975	18,500	"
"	"	"	"	19.0	2175	26,400	"
"	"	"	Unique	11.0	1805	18,500	"
"	"	"	"	15.8	2175	26,400	"
111	"	.406	Lightning	20.0	2015	20,000	"
"	"	"	"	27.0	2460	36,000	"
"	"	"	Sharpshooter	18.0	2130	23,000	"
"	"	"	"	22.2	2505	40,000	"
"	"	"	2400	16.0	1915	20,200	"
"	"	"	"	21.0	2275	34,600	"

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
111	Gas-check	.406	Unique	10.0	1630	20,000	Her.
"	"	"	"	15.1	2050	40,000	"
117	MC	.465	3031	35.0	2650		Du P.
"	"	.43	"	36.5	2700	46,000	"
"	"	.35	"	38.0	2900[1]	50,000[2]	NHR
"	"	"	1147	38.0	2900[1]	52,000[2]	"
"	"	.437	HiVel 2	23.0	1980		Her.
"	"	"	"	31.0	2460	34,000	"
"	"	"	"	36.8	2870	50,000	"
"	"	"	HiVel 3	21.0	1940		"
"	"	"	"	27.0	2300	32,400	"
"	"	"	"	32.7	2800	50,000	"
"	"	"	Sharpshooter	17.0	1950	27,000	"
"	"	"	"	22.5	2370	40,000	"
"	"	"	2400	16.0	1655	21,000	"
"	"	"	"	20.0	2220	40,000	"
"	"	"	4064	38.0			NHR
"	"	"	"	39.0			"

[1] Estimated velocity.
[2] Estimated pressure.

loading and permits of a wide variety of bullets. This cartridge Major Roberts now uses exclusively in preference to his old .25 Roberts, chiefly because of the convenience of purchasing cases rather than using hand-drawn types. His favorite bullet weight is around 100 grains, but the author is partial to the 87-grain load for varmint shooting.

Bullets in this caliber are somewhat expensive, being in the same price class as those of the Springfield—$28.35 per 1000; .25 Remington auto-loading bullets, which look almost identical, can be used with excellent success, and several hundred of them have been shot by the author and his friends. One must bear in mind, however, that it is impossible to drive the .25 Remington bullet at velocities much greater than 3000 f.s. without inviting disaster. The bullet was never intended for such high speed and the jacket is not sufficiently sturdy. When pushed up to the standard factory velocity of the regular 87-grain load, this .25 Remington bullet will frequently make groups as small as one inch at 100 yards for eight shots, throwing two of these shots at least two inches away from the rest of the main group. At other times, when shot at 100 yards, the bullets actually fail to arrive, and they rarely arrive when a shot is fired at small game through thick grass. Finest results with this particular bullet are obtained with 3031 and 4064 powders. For the best of accuracy, seat your bullets so that they just contact the leade of the rifling if possible. In some cases this will not permit a cartridge to run through the magazine, owing to added length, but in single-shot work in varmint shooting, best results can be so obtained. In use with the cast bullet, the majority of .25 calibers perform excellently except the 60-grain. The 65-grain gas-check performs excellently. The 60-grain

hollow point is also of no value according to Major Roberts, as its accuracy is very poor, and erratic shots are a common occurrence. One or two friends using the .250/3000 Savage, have rechambered these barrels for the .257 Roberts and report reasonable results. Performances are generally very poor, however, as the twist of the Savage barrel is not sufficiently great to handle the bullet properly; 8 to 10 inches performs best.

6.5 MM. MANNLICHER-SCHOENAUER

The 6.5 mm. MS cartridge is an extremely popular number in this country. It is much shorter than the standard cartridges in these calibers and is adapted to the very excellent Mannlicher-Schoenauer rifle obtainable everywhere. Any of the standard 6.5 mm. bullets will work satisfactorily in this, but the long slender bullet requires an extremely quick twist to spin it properly. The same twist with unusually short bullets is inclined to give erratic shooting. This Mannlicher cartridge is designed for the turn-bolt types of action.

6.5 mm. Mannlicher-Schoenauer

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 18-in. Barrel	Breech Pressure	Recommended by
100	WTCW	.225	3031	37.0	2680		Du P.
"	"	"	"	42.0	3000		"
"	"	"	15½	43.0	2705		"
"	"	"	"	45.0	2895		"
"	"	"	17½	43.0	2850		"
112	Lead	"	GR 75	12.0	1500		"
129	Open Point	28	3031	32.5	2270		"
"	Newton	.275	"	33.0	2320		"
"	"	.28	"	37 5	2580		"
"	"	.275	"	38.0	2610		"
"	"	"	15½	33.5	1975		"
"	"	"	"	44.0	2660		"
"	"	"	17½	23 5	1775		"
"	"	"	"	41 0	2615		"
"	"	"	HiVel 2	35.4	2410		Her.
"	"	"	16	39.0	2500		Du P.
"	"	.28	4064	35.0	2290		"
"	"	"	"	40 5	2600		"
135	WTCW	.275	17½	40 0	2445		"
140	"	.300	3031	32 0	2230		"
"	"	"	"	36 5	2470		"
"	"	275	17½	26 0	1750		"
"	"	"	"	39.5	2470		"
"	"	"	15½	30.0	1825		"
"	"	"	"	42 5	2560		"
"	Open Point	.30	3031	31.0	2140		"
"	"	"	"	36.0	2450		"
"	"	"	4064	33 5	2160		"
"	"	"	"	39 0	2480		"
150	SP	.225	15½	32.0	1825		"
"	"	"	"	43.5	2425		"
"	"	"	17½	29 0	1775		"
"	"	"	"	39.5	2300		"
160	MCR Nose	.300	3031	29 0	1960		"
"	"	"	"	33 5	2220		"
"	"	"	15½	30 5	1840		"
"	"	"	"	40 0	2320		"
"	"	"	17½	27 5	1810		"
"	"	"	"	36.0	2215		"
"	"	"	21	33.5	2250		"
"	"	.30	4064	32.0	1990		"
"	"	"	"	37.0	2260		"

6.5 MM. STEYR MANNLICHER

This cartridge is very similar to the Mannlicher-Schoenauer previously described. It does, however, use a rimmed type of case rather than a rimless. It is intended for the straight-pull bolt type of Mannlicher action.

6.5 mm. Steyr-Mannlicher

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 28½-in. Barrel	Breech Pressure	Recommended by
100	WTCW	.225	3031	37.0	2895		Du P.
"	"	"	"	42.2	3195		"
"	"	"	15½	43.0	3020		"
"	"	"	"	45.0	3180		"
112	Lead	.350	SR 80	13.7	1573		"
123	SP	.200	15½	38.0	2460		"
"	"	"	"	43.5	2850		"
"	"	"	17½	40.6	2730		"
129	Newton	.275	3031	33.0	2485		"
"	"	"	"	38.0	2760		"
"	OP	.28	"	32.5	2440		"
"	"	"	"	37.5	2750		"
"	"	"	4064	35.0	2460		"
"	"	"	"	40.5	2770		"
135	SP	.300	15½	37.0	2350		"
"	"	"	"	42.0	2670		"
"	"	"	16	39.5	2700[1]		"
140	OP	.30	3031	31.0	2310		"
"	WTCW	.300	"	32.0	2350		"
"	OP	.30	"	36.0	2615		"
"	"	"	"	36.5	2620		"
"	Lubaloy	.275	15½	36.4	2300		"
"	"	"	"	41.4	2630		"
"	"	"	17½	30.0	2170		"
"	"	"	"	39.0	2660		"
"	"	"	1147	36.0	2360		"
"	"	"	"	41.0	2650		"
"	"	"	16	33.0	2350[2]		"
"	"	"	"	35.0	2470[2]		"
"	"	"	"	38.0	2675[2]		"
"	OP	.30	4064	33.5	2330		"
"	"	"	"	39.0	2645		"
150	SP	.225	17½	30.5	2100		"
"	"	"	"	39.5	2565		"
"	"	"	1147	37.5	2300		"
"	"	"	"	40.8	2530		"
160	MC	.300	3031	29.0	2100		"
"	"	"	"	33.5	2300		"
"	Lubaloy	.275	15½	34.3	2175		"
"	"	"	"	38.4	2375		"
"	"	"	17½	27.5	1925		"
"	"	"	"	37.0	2400		"
"	"	"	1147	34.0	2095		"
"	"	"	"	39.2	2400		"
"	"	"	16	40.0	2475[2]		"
"	"	"	21	33.0	2700[2]		"
"	"	"	15	40.0	2475[2]		"
"	Round Nose	.30	4064	32.0	2130		"
"	"	"	"	37 0	2400		"

[1] Estimated velocity.
[2] Velocity with corrosive primer.

.256 NEWTON

The .256 Newton is also a development of the late Charles Newton. Many cartridges bearing the imprint "N.A. Company" are to be found on the market. Remington also made shells and at one time furnished loaded cartridges, as did the Western Cartridge Company. Western, at this writing, still includes the .256 in its list.

The .256 Newton was the most popular number of the entire Newton series and was personally the pet of Sir Charles. It was an excellent performing cartridge with a velocity of 3100 f.s. with a 123-grain bullet. At one time it was loaded by Newton with a 140-grain bullet at a velocity of 3000 f.s. Newton once told the author that his favorite squirrel cartridge was the .256 with a full

metal-cased 100-grain bullet and 10 grains of Sharpshooter powder. He used this cartridge on small game such as squirrel, rabbit, grouse, ducks, and other water fowl, for direct body shots without mutilation. I have never tried this particular load, but he insisted that it was nearly as accurate as the .22 Long Rifle.

The unfortunate part of the .256 cartridge is that the manufacturing tolerances of the old Newton firm are by no means up to Winchester and Remington standards. Several sizes of barrels were made, but the majority of them were greatly oversize. The 129-grain bullet manufactured by the Western Cartridge Company at present, has a diameter of .264, indicating that the average bore diameter must be well over .26 caliber. This cartridge is essentially the .30/06 necked down and was one of the first practical attempts at producing a large capacity .25 caliber. It is a pleasant cartridge to shoot, is extremely accurate and has low recoil.

.256 Newton

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
100	WTCW	.225	17½	31.0	2450		Du P.
"	"	"	"	43.0	3025		"
"	"	"	"	45.0	3100		JBS
"	"	"	"	45.5		Max.	"
108	Lead	.350	SR 80	11.0	1160		Du P.
"	"	"	"	15.6	1560		"
"	"	"	Lightning	15.0			Her.
"	"	"	GR 75	9.5	1140		Du P.
"	"	"	"	11.8	1380		"
"	"	"	"	13.7	1550		"
123	MC	.250	17½	30.0	2140		"
"	"	"	"	44.0	2818		"
"	"	"	18	40.0	2575[1]		"
"	"	"	"	43.0	2765[1]		"
129	SP	.350	15½	41.4	2500		"
"	"	"	"	48.0	2845		"
"	"	"	"	50.4	3000	Max.	"
"	"	"	HiVel 2	44.0	[redacted]	Max.	JBS
"	"	"	Her.300	44.5	2750[1]	52,900	Her.
"	"	"	15	47.5	2825[1]		Du P.
"	"	"	SR 80	18.0	1550		"
130	"	"	17½	33.0	2240		"
"	"	"	"	43.5	2725		"
140	Lubaloy 6.5 mm.	.300	15½	42.3	2420		"
"	"	"	"	49.5	2875		"
"	"	.275	17½	37.0	2360		"
"	"	"	"	47.0	2860		"
"	"	"	18	39.0	2400		"
"	"	"	"	43.5	2675		"
"	"	"	SR 80	12.5	1125		"
"	"	"	"	17.5	1525		"
150	SP 6.5 mm.	.250	15½	42.0	2290		"
"	"	"	"	49.0	2680		"
"	"	"	17½	37.5	2190		"
"	"	"	"	45.5	2600		"
"	"	"	18	37.5	2160		"
"	"	"	"	43.5	2500		"
160	6.5 mm.	.300	15½	37.5	2150		"
"	"	"	"	46.0	2510		"
"	"	"	17½	32.5	2015		"
"	"	"	"	42.0	2460		"
"	"	"	18	32.5	1980		"
"	"	"	"	40.0	2360		"

[1] Velocity with corrosive primer.

.270 WINCHESTER

The .270 Winchester cartridge is another necked-down job on the .30/06 cartridge. This was first produced by Winchester in 1923 but not announced for several years thereafter. The author first saw this in the Model 54, for which it was designed, during a visit at the factory in the above-mentioned year. He shot it quite extensively on the Winchester 100-yard indoor range and was extremely pleased with the low recoil. When Winchester announced this with the 130-grain bullet, it immediately achieved a great deal of popularity throughout the United States. There was much talk, however, of the high-velocity bullet mutilating

.270 Winchester

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
95	HP WTCW	.220	2400	15.0	1575		Her.
"	"	"	"	22.0	2100	20,000	"
"	"	"	"	27.0	2490	30,000	"
"	"	"	"	30.2	2725	40,000	"
"	"	"	"	33.2	2960	55,000	"
"	"	"	HiVel 2	22.0	1500		"
"	"	"	"	38.0	2710	29,000	"
"	"	"	"	45.8	3280	55,000	"
"	"	"	HiVel 3	20.0	1660		"
"	"	"	"	32.0	2635	28,900	"
"	"	"	"	42.4	3340	55,000	"
"	"	"	Unique	14.0	1875	21,500	"
"	"	"	"	19.8	2335	40,000	"
"	"	3¼[1]	15½	58.0	3400	54,000	HAD
"	"	.220	Sharpshooter	21.0	2150	19,400	Her.
"	"	"	"	30.8	2885	40,000	"
"	"	"	Lightning	20.0	1660		"
"	"	"	"	32.0	2490	26,800	"
"	"	"	"	43.6	3250	55,000	"
100	"	.275	3031	42.0	2930		Du P.
"	"	"	"	50.0	3250		"
"	"	.225	15½	45.0	2640		"
"	"	"	"	58.0	3360		"
"	"	.275	17½	42.0	2675		"
"	"	"	"	53.0	3250		"
"	"	"	SR 80	12.0	1150		"
"	"	"	"	16.2	1550		"
111	Lead	.336	2400	10.0	1291	8,900	Her.
"	"	"	HiVel 3	12.0	1337	7,900	"
"	"	"	SR 80	10.0			HGL
"	"	"	"	11.5	1400		Du P.
"	"	"	"	14.0	1625		"
"	"	"	Unique	8.0	1402	11,900	Her.
"	"	"	Lightning	15.0	1400	8,600	"
"	"	"	Sharpshooter	10.0	1246	8,300	"
116	B&M	3¼[1]	2400	12.0	1600		HAD
"	1-20 Alloy .2805 diam.	"	Du P. Shot Gun	12.0	1400		"
"	"	"	Unique	9.0	1400		"
"	"	"	Oval	12.0	1400		"
"	"	"	SR 80	10.5	1300		"
125	Lead	.350	"	12.0	1450		Du P.
"	"	"	"	15.0	1595		"
129	SP	.300	"	13.7	1140		"
"	"	"	"	18.0	1560		"
130	"	.319	2400	17.0	1500		Her.
"	"	"	"	20.0	1750	19,500	"
"	"	"	"	24.0	2040	27,000	"
"	"	"	"	28.2	2300	40,000	"
"	"	"	"	31.2	2460	55,000	"
"	"	"	HiVel 2	25.0	1640		"
"	"	"	"	36.0	2310	28,500	"
"	"	"	"	47.8	3020	55,000	"
"	"	"	"	48.0	3100	Max.	JBS
"	"	"	HiVel 3	19.0	1490		Her.
"	"	"	"	30.0	2235	26,800	"
"	"	"	"	40.4	2855	55,000	"
"	"	"	Unique	13.0	1470	20,200	"
"	"	"	"	19.8	2005	40,000	"
"	"	.30	3031	37.0	2545		Du P.
"	"	"	"	40.0	2675		"
"	"	"	"	48.0	3015		"
"	"	"	17½	44.0	2585	45,000	"
"	"	"	"	50.0	2920		"
"	"	"	15½	47.0	2705		"
"	"	"	"	53.5	3035	53,000	"
"	"	"	"	55.0	3.60		"

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
130	SP	.30	SR 80	20.0	1675		Her.
"	"	"	"	23.0	1835		"
"	"	"	1204	30.0	2264		"
"	"	"	"	32.0	2400		"
"	"	.319	Sharpshooter	20.0	1825	21,000	Her.
"	"	"	"	29.4	2470	40,000	"
"	"	"	Lightning	22.0	1655		"
"	"	"	"	30.0	2165	27,000	"
"	"	"	"	41.4	2890	55,000	"
"	"	.30	4320	42.0	2645		Du P.
"	"	"	"	52.0	3110		"
"	"	"	4064	40.0	2565		"
"	"	"	"	49.5	3090		"
"	Lead	383	2400	13.0	1458	10,200	Her.
"	"	"	HiVel 2	18.0	1415	7,300	"
"	"	"	HiVel 3	12.0	1228	4,100	"
"	"	"	"	14.0	1347	7,900	"
"	"	"	Unique	10.0	1460	10,200	"
"	"	"	Lightning	12.0	1184	4,600	"
"	"	"	Sharpshooter	8.0	1109	5,000	"
138	GC	.395	HiVel 2	15.0	1230	7,500	"
"	"	"	"	25.0	1810	18,500	"
"	"	"	Unique	8.0	1240	15,000	"
"	"	"	"	15.0	1800	29,000	"
140	B&M-GC	3⅛[1]	HiVel 3	26.0	2300		HAD
"	"	"	18	25.0	2000		"
"	"	"	1204	20.0	1800		"
"	"	"	SR 80	16.0	1800		"
145	HP WTCW	.276	2400	18.0	1570		Her.
"	"	"	"	19.0	1645	19,500	"
"	"	"	"	24.0	2040	27,800	"
"	"	"	"	27.8	2170	40,000	"
"	"	"	"	31.9	2460	55,000	"
"	"	"	HiVel 2	24.0	1520		"
"	"	"	"	36.0	2200	28,500	"
"	"	"	"	45.8	2755	55,000	"
"	"	"	HiVel 3	21.0	1610		"
"	"	"	"	31.0	2180	28,500	"
"	"	"	"	39.0	2640	55,000	"
"	"	"	Unique	13.0	1435	20,900	"
"	"	"	"	19.4	1825	40,000	"
"	"	.300	3031	39.0	2510		Du P.
"	"	"	"	46.0	2800		"
"	"	"	15½	47.6	2600		"
"	"	"	"	51.7	2855		"
"	"	"	17½	44.4	2535		"
"	"	"	"	47.0	2675		"
"	"	.276	Sharpshooter	20.0	1730	21,200	Her.
"	"	"	"	28.4	2250	40,000	"
"	"	"	Lightning	23.0	1655		"
"	"	"	"	30.0	2085	27,000	"
"	"	"	"	39.8	2625	55,000	"
150	SP	.355	2400	17.0	1420		"
"	"	"	"	20.0	1660	20,700	"
"	"	"	"	23.0	1845	27,700	"
"	"	"	"	27.0	2080	40,000	"
"	"	"	"	31.0	2280	55,000	"
"	"	"	HiVel 2	25.0	1535		"
"	"	"	"	35.0	2150	28,200	"
"	"	"	"	45.4	2690	55,000	"
"	"	"	HiVel 3	20.0	1515		"
"	"	"	"	29.0	2095	27,000	"
"	"	"	"	37.6	2570	55,000	"
"	"	"	Unique	13.0	1325	20,400	"
"	"	"	"	19.4	1820	40,000	"
"	"	"	Lightning	23.0	1660		"
"	"	"	"	30.0	2100	29,200	"
"	"	"	"	39.0	2585	55,000	"
"	"	"	Sharpshooter	20.0	1720	21,500	"
"	"	"	"	28.0	2215	40,000	"

[1] Overall length.

too much meat, and accordingly the Western Cartridge Company, in 1933, produced a .270 load with a 150-grain soft-point bullet at a lower velocity. This load is also a very excellent killer and is to be preferred to the other for all short-range shooting. For varmints Winchester has just introduced a 100-grain protected-point load at a muzzle velocity of 3630 f.s. For handloading purposes, the major objection to the .270 Winchester is the lack of variety in the bullets available in other than the cast variety. Metal-cased bullets of other calibers do not fit properly.

7 MM. MAUSER

The 7 mm. Mauser is a military cartridge designed essentially for the Model 1893 Mauser rifle. Since that time it has been widely adopted, so that at present no less than fifteen different nations use this cartridge as standard. In Europe it is known as a 7x57, as the cartridge case is 57 mm. long. This cartridge is ideal for handloading purposes. Properly loaded, its accuracy can equal that of any of our more modern cartridges. In the United

7 mm. Mauser (7 x 57)

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
88	Lead	.201	Unique	5.0	1140	7,400	Her.
"	"	"	"	10.0	1740	16,000	"
"	"	"	Lightning	8.0	875	5,000	"
"	"	"	"	16.0	1495	10,600	"
"	"	"	GR 75	5.0	850[1]		Du P.
110	WTCW	200	17½	47.5	3025		"
120	Lead	.347	Unique	4.0	875	7,800	Her.
"	"	"	"	10.0	1570	18,400	"
"	"	"	GR 75	8.0	1050		Du P.
139	MC	.288	2400	10.0	1075		Her.
"	"	"	"	16.0	1500	20,000	"
"	"	"	"	20.0	1785	25,500	"
"	"	"	"	25.6	2200	40,000	"
"	"	"	"	28.4	2375	53,000	"
"	"	"	HiVel 2	20.0	1355		"
"	"	"	"	31.0	2035	25,000	"
"	"	"	"	42.0	2715	53,000	"
"	"	"	HiVel 3	13.0	1175		"
"	"	"	"	25.0	1925	24,000	"
"	"	"	"	36.6	2665	53,000	"
"	"	"	Unique	11.0	1240	20,500	"
"	"	"	"	16.9	1720	40,000	"
"	"	"	Lightning	16.0	1225		"
"	"	"	"	26.0	1905	25,500	"
"	"	"	"	37.0	2650	53,000	"
"	"	"	Sharpshooter	10.0	1100		"
"	"	"	"	19.0	1735	25,000	"
"	"	"	"	25.2	2200	40,000	"
"	"	"	"	29.3	2470	53,000	"
"	"	"	"	37.0	2465		Du P.
"	"	.250	3031	39.0	2580		"
"	"	"	"	42.5	2795		"
"	"	"	18	40.0	2500[1]		"
"	"	"	"	44.0	2670[1]		"
"	"	"	"	45.5	2775[1]		"
"	"	"	21	40.5	2660[1]		"
"	"	"	16	42.8	2685[1]		"
"	"	"	"	46.0	2875[1]	53,000	"
"	"	"	1147	44.0	2475		"
"	"	"	"	48.8	2775		"
"	"	"	17½	46.0	2675		"
"	"	"	"	47.8	2800		"
"	"	"	15½	46.5	2600		"
"	"	"	"	49.0	2805		"
"	"	"	15	46.0	2775[1]		"
"	"	.288	Her. 300	44.7	2675[1]	45,000	Her.
"	"	.250	SR 80	18.0	1500		Du P
"	"	"	Pyro	43.0	2675[1]		"
"	"	"	4064	40.0	2500		"
"	"	"	"	46.0	2875		"
"	"	"	4320	39.0	2475		"
"	"	"	"	46.0	2890		"
"	GC	.341	2400	8.0	1070		Her.
"	"	"	"	17.0	1665	20,000	"
"	"	"	"	19.0	1880	23,900	"
"	"	"	"	25.2	2200	40,000	"
"	"	"	"	27.8	2375	53,000	"
"	"	"	HiVel 2	15.0	1220		"
"	"	"	"	30.0	2085	24,300	"

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
139	GC	.341	HiVel 2	41.5	2725	53,000	Her.
"	"	"	HiVel 3	12.0	1110		"
"	"	"	"	26.0	2075	25,000	"
"	"	"	"	35.4	2550	53,000	"
"	"	"	Lightning	11.0	1100		"
"	"	"	"	24.0	1900	24,300	"
"	"	"	"	36.0	2625	53,000	"
"	"	"	Sharpshooter	10.0	1305		"
"	"	"	"	19.0	1895	25,700	"
"	"	"	"	25.0	2300	40,000	"
"	"	"	"	28.4	2495	53,000	"
"	"	"	Unique	5.0	850		"
"	"	"	"	10.0	1395	20,700	"
"	"	"	"	11.0	1460	23,500	"
"	"	"	"	16.0	1845	40,000	"
"	"	"	"	19.4	2055	53,000	"
"	"	"	GR 75	15.0	1420		Du P.
150	HP	.260	HiVel 2	18.0	1140		Her.
"	"	"	"	30.0	2000	25,000	"
"	"	"	"	41.2	2655	53,000	"
"	"	"	HiVel 3	13.0	1125		"
"	"	"	"	25.0	1825	24,000	"
"	"	"	"	35.6	2540	53,000	"
"	"	"	Lightning	16.0	1300		"
"	"	"	"	25.0	1860	25,500	"
"	"	"	"	35.6	2520	53,000	"
154	DWM BT	.375	15½	44.5	2525	43,200	PBS
"	"	"	"	45.0	2550	46,330	"
"	DWM Ex SJ	"	"	44.0	2434	49,520	"
"	"	"	"	45.0	2500	52,200	"
"	DWM SP	"	"	44.0	2439	43,100	"
"	DWM HP	"	"	44.0	2430	43,500	"
162.5	DWM BT Ex.	.525	"	43.0	2412	50,720	"
175	MC	.363	HiVel 2	18.0	1220		Her.
"	"	"	"	30.0	1865	26,400	"
"	"	"	"	39.8	2415	53,000	"
"	"	"	HiVel 3	13.0	1090		"
"	"	"	"	25.0	1810	27,300	"
"	"	"	"	34.4	2350	53,000	"
"	"	"	Unique	8.0	815		"
"	"	"	"	11.0	1140	20,500	"
"	"	"	"	12.0	1210	23,500	"
"	"	"	"	16.5	1560	40,000	"
"	"	"	"	19.6	1750	53,000	"
"	"	"	Lightning	18.0	1275		"
"	"	"	"	25.0	1715	26,000	"
"	"	"	"	34.5	2320	53,000	"
"	"	.400	3031	33.0	2085		Du P.
"	"	"	"	34.5	2150		"
"	"	"	"	40.0	2405		"
"	"	"	17½	33.3	1950		"
"	"	"	"	38.0	2200		"
"	"	"	"	43.2	2425		"
"	"	"	15½	40.4	2200		"
"	"	"	"	43.4	2400		"
"	"	"	1147	38.0	2150		"
"	"	"	"	45.5	2475		"
"	"	"	18	34.0	2035[1]		"
"	"	"	"	36.9	2150[1]		"
"	"	"	"	40.0	2300[1]		"
"	"	"	16	32.0	2200[1]		"
"	"	"	"	36.5	2440[1]		"
"	"	"	21	35.0	2200[1]		"
"	"	"	SR 80	18.0	1250		"
"	"	"	15	41.0			"
"	"	"	Her 300	38.8	2310[2]	42,500	Her.
"	"	"	4064	36.0	2130		Du P.
"	"	"	"	42.0	2450		"
"	"	"	4320	35.0	2230		"
"	"	"	"	42.0	2580		"

[1] Estimated velocity.
[2] Velocity with corrosive primer.

States only two 7 mm. bullets are manufactured, a 139-grain weight and the heavy 175-grain. There is, however, a slight amount of variation in available bullets, since Remington has a 175-grain hollow point and the same weight in a soft point. All makers have a 139-grain pointed, full-jacketed bullet, and a 139-grain hollow point. The Western Cartridge Company makes a very excellent 175-grain boat-tail with a soft point.

Europe, however, has a great variety of bullet weights due to the greater development of the 7 mm. cartridge over there. Germany makes 7 mm. bullets running from 110 grains up to over 200 grains. A very excellent number weighs 154 grains. The author imported a batch of German bullets several years ago in six different weights and a total of fourteen or fifteen different styles. Loads were developed at the Du Pont Laboratory and it was found that these bullets could be consistently driven into one-inch groups at 100 yards with a standard Model 54 Winchester. The Standard Military cartridge is loaded both with the 139-grain pointed full jacket, and with a 175-grain round-nose full jacket. A number of cast bullets can be obtained to round out the line. Properly loaded, this cartridge leaves very little to be desired, as it permits of excellent killing power for small game, or big game, together with the accuracy necessary for target shooting.

.275 HOLLAND & HOLLAND MAGNUM

The .275 Holland & Holland Magnum is the smallest of the H. & H. series. Essentially, this is the large-capacity cartridge case of 7 mm. caliber with a belted type of cartridge case. The fact that the .275 H. & H. in the groove diameter is almost identical with the 7 mm. rifle series, makes it an extremely simple matter for the handloader to secure suitable bullets. The cartridge case has a long

.275 H. & H. Magnum

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 26-in. Barrel	Breech Pressure	Recommended by
110	WTCW		17½	60.0	3300		JBS
139	HP	.325	15½	51.0	2770		Du P.
"	"	"	"	54.0	2930		"
"	"	"	"	59.0	3100[1]	Max.	JBS
"	WTCW	"	"	60.0	3200	Max.	"
"	HP	"	SR 80	17.0	1515		Du P.
"	"	"	"	22.0	1820		"
"	Western FMJ	.329[2]	15½	58.0	2920[3]	49,100	JVH
"	"	"	"	60.0	3050[3]	54,750[4]	"
"	"	"	16	52.0	2940[3]	49,000	"
"	"	"	"	54.0	3055[3]	56,000[4]	"
150	WTCW		HiVel 2	53.0	3000		JBS
160	Kynoch		"	49.5			"
"	"	3.29[2]	"	50.0	2820[3]	57,600[4]	JVH
"	"	"	15½	57.0	2815[3]	51,200	"
"	"	"	"	58.0	2910[3]	58,600[4]	"
"	"	"	Neonite[5]	48.0	2580	50,520	"
170	WTCW		15½	55.0	2700		JBS
175	SP	.350	"	49.5	2525		Du P.
"	"	3.29[2]	"	50.0	2425[3]	41,000	JVH
"	"	"	"	55.0	2650[3]	46,000	"
"	"	"	"	58.0	2770[3]	53,875[4]	"
"	"	.350	SR 80	21.0	1540		Du P.
"	"	"	"	23.0	1650		"
"	"	3.29[2]	HiVel 2	50.0	2720[3]	57,000[4]	JVH
"	"	"	16	48.0	2610[3]	51,000	"
"	"	"	"	50.0	2715	57,000[4]	"

[1] Estimated velocity.
[2] Overall length of cartridge.
[3] FA tests with FA primers.
[4] Dangerous pressures.
[5] Holland and Holland factory load tested at FA for velocity and

gentle taper with a gradual shoulder, and handles excellently as a properly designed loading tool. It is capable of excellent accuracy. The cartridge is factory-loaded by the Western Cartridge Company at the present time, and it is possible that this particular caliber will be made available in the new Winchester Model 70 at a later date if they decide to add the entire H. & H. series to their lines. Although of English origin, it is rapidly coming to the front as an extremely popular rifle cartridge in this country.

.277 ELLIOTT EXPRESS

The Elliott Express series of cartridges was designed and developed by O. H. Elliott, noted experimenter and gunsmith of the firm of O. H. Elliott & Co., South Haven, Michigan. Mr. Elliott prepared these numbers to fill a demand for modern up-to-date cartridges in rimmed cases, adaptable to single-shot and double-barrel rifles.

The series consists of the .277, .303 and .357 calibers. They are more or less comparable to the .270 Winchester, .30/06 Springfield and .35 Whelen, respectively. All three are made by reshaping the .405 Winchester new cases and are sufficiently thick and heavy to withstand high-pressure loads and repeated reloadings. In the loading data herewith supplied by Mr. Elliott, who has made extensive tests with this equipment, no breech pressures are available, due to lack of pressure guns for these calibers at the present time. He reports that the loads have been shot extensively, including loads suitably heavier than those indicated, thus insuring that "the maximum loads are under the safety limits of properly constructed and chambered arms." He is able to supply imported double rifles and American or imported single-shot rifles for any cartridge in this series. All of these are available strictly to order and of the highest-quality custom work.

As this book was going to press, Mr. Elliott advised the author that breech pressures apparently were 50,000 pounds, and that these loads are adaptable to the heavier British single-shot actions, such as the Rigby, Bland, Farquharson, heavy-barrel Winchesters, and so forth. All rifles in this series use eight-groove barrels. Mr. Elliott finds that this enables him to use higher velocities with lower pressures.

Another last-minute announcement from Mr. Elliott states that the British Greener firm is tooling up to make double rifles for Elliott, to order, for all three of these new calibers. Greener has been noted for many years for turning out excellent custom work. One of the new doubles for the .357 Express had just been received by Mr Elliott at that time.

Barrel data on the .277 Elliott Express run as follows: Bore diameter, .277 inch; groove diameter, .284 inch; eight-groove rifling with ten-inch twist.

.277 Elliott Express

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 28-in. Barrel	Breech Pressure	Recommended by
139	Western HP 7 mm.	.300	4320	44.0	2840		OHE
"	"	"	"	50.0	3120		"
"	"	"	4064	40.0	2650		"
"	"	"	"	48.0	3130		"
175	Western SPBT 7 mm	.430	4064	38.0	2460		"
"	"	"	"	44.0	2720		"

.28/30 STEVENS CARTRIDGE

This cartridge was designed and placed on the market in the autumn of 1900 by the J. Stevens Arms & Tool Co. It was designed by Mr. Charles H. Herrick, and was highly recommended by no less an authority than the famous Harry M. Pope.

The first rifles made for it were the Stevens Ideal in their various grades, while Mr. Pope made barrels fitted to Stevens, Ballard, Winchester S. S., etc., for this cartridge, both in breech-loading and muzzle-loading types. The first factory-loaded cartridges were made by the old "UMC Co.," Bridgeport, Conn., and were loaded with a charge of 30 grains Fg black powder and a 120-grain grooved bullet seated in the case to cover all the grooves. The overall length of this cartridge was 2¼ to 2-13/16 inches. The rifle cranks soon adopted the "habit" of priming this cartridge with about 5 grains bulk Du Pont #1 Rifle Smokeless, Du Pont Shotgun Smokeless, or Schuetzen smokeless, with the rest of the case filled with Fg black, or Kings Semi-Smokeless Fg powder, a wad on the powder (card, blotting paper, or felt) and breech-seated the 135- or 136-grain Ideal bullet about 1/16 inch ahead of the case.

Loaded in this way it was a remarkably accurate-shooting cartridge, shot very clean, and one could fire a hundred shots without cleaning the rifle and get as fine accuracy with the last shot as with the first. The velocity with these smokeless primed loads was about 1500 f.s. Later the riflemen adopted low-power smokeless loads for this cartridge.

With Pope, Peterson, Schoyen, or Zischang barrels in such actions as the Ballard, Stevens Ideal

#44½, Winchester S.S., Remington-Hepburn, or Sharps-Borchardt, the .28/30 cartridge would make as fine groups at 100, 200 and 300 yards as have ever been made with the .32/40 cartridge. Riflemen who own Pope, Zischang, or Schoyen barrels in this caliber fitted to any of the above actions today prize them very highly, and such rifles command prices even higher than these fine arms originally cost.

Pope recommended the 118-grain bullet for breech-loading and the 136-grain bullet, of his make, for muzzle-loading with his rifles for the best accuracy; and with the best loads and the 136-grain Pope bullet, loaded either from the breech or muzzle, these rifles would average well under one-inch ten-shot groups at 100 yards rest, with frequent 2- to 2½-inch groups at 200 yards.

Bullets should be cast about 1 to 35 tin and lead for use with black or semi-smokeless loads primed with low-pressure smokeless, and the lubricant should be rather soft. For the smokeless powder loads the lubricant should be a hard, high-melting one, and the bullets should be cast about 1 to 25 tin and lead.

The .28/30 case is straight taper on the outside, the empty case being 2½ inches long, and the 120-grain bullet is seated 15/32 inch in the case. We have a great variety of .28 caliber cast bullets ranging from 84 grains to 181 grains weight. The best of these bullets for shooting woodchucks and vermin is the 112-grain hollow-point. For target work the most accurate bullets are the 135-grain flat-point Ideal, the 136-grain Ideal pointed, and the 135-grain Pope flat-pointed bullets. The 138-grain Ideal gas-check bullet cast 1 to 15 with a charge of Du Pont #1204 is reported as giving especially fine accuracy at 100 and 200 yards.

N. H. Roberts

.28/30 Stevens

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 28-in. Barrel	Breech Pressure	Recommended by
132	Ideal Cast 1-30	17 grs. Schuetzen			1600		NHR
135	"	5 grs. Fg Black 34 grs. bulk Schuetzen			1600		" "
136	Pointed, Ideal 1-30	5 grs. Fg Black 13 grs. Du P. 80			1600		"
136	Pope 1-30	5 grs. Fg Black 13 grs. Du P. 80			1600		"
	Use card, blotting paper, or felt wad, cut from old hat, on powder and breech-seat bullet about ⅛ inch ahead of case. All give 1-inch groups, or less at 100 yards rest, scope sight; 2 to 3 inches at 200 yards also. N H R						
138	Ideal 258346		1204	13.0			JBS
"	"		2400	12.2			"

.280 ROSS

This was a large-capacity cartridge, one of the first so-called "magnums" to be developed. It was built for the Model 1910 Ross rifle of Canadian manufacture. This was a straight-pull bolt with magnum action. Although the cartridge is excellent, it never grew popular because the Ross rifle left a great deal to be desired as a sporting and target arm. The actions of Springfield and commercial American bolt-action guns are not sufficiently large to handle the long cartridge. It is rapidly falling into the discard, but can be loaded to give very excellent accuracy and power.

.280 Ross

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 28-in. Barrel	Breech Pressure	Recommended by
139	GC	.300	SR 80	25.2	2055		Du P.
"	"	"	GR 75	20.0	1860		"
"	MC		15	56.0	3062	45,620	CGW
143	"	.375	SR 80	16.0	1525		Du P.
"	"	"	"	25.0	2015		"
"	"	"	15½	57.5	3050		"
"	"	"	"	60.1	3200		"
"	"	"	17½	57.0	3050		"
"	"	"	15	56.0	3060	45,620	CGW
"	"	"	"	60.0	3300	45,980	"
"	"	"	10	57.0	3050	53,000	"
145	Steel HP		HiVel 2	56.0	3228	52,560	Her.
"	"		Her.300	55.7	3000	41,500	"
"	"		"	56.2	3070	52,600	"
150	MC		10	53.0			Du P.
158	"		15	58.2	3036	56,120	CGW
160	"		10	54.0			Du P.
"	"		Her.300	53.3	2860		Her.
"	"		"	55.6	2926	50,400	"
180	"		10	52.0			Du P.
188	"		15	54.0	2730	55,360	CGW
"	"		10	54.0	2800	52,300	"

Velocity with corrosive primer on all loads.

7.5 MM. SWISS

This cartridge is a rimless type very similar to the Springfield but somewhat shorter in overall length and with a much sharper shoulder on the neck. It is not frequently found in this country but is handloaded to a certain extent for military rifles. The factory cartridge case is equipped with a Berdan primer with twin flash holes. Many handloaders remove this primer, reform the pocket to a certain extent, and use an American type of primer. Any of the standard, .30-caliber bullets will work in this particular cartridge case, as it is

7.5 mm. Swiss

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 31½-in. Barrel	Breech Pressure	Recommended by
174	MC BT		Swiss	49.3	2660	40,000	Factory (Swiss)
"	"		1147	48.5	2660	39,000	PBS

essentially of the same groove diameter as the Springfield. The standard 174-grain boat-tail bullet is very similar to the Mark I bullet.

.30 REMINGTON

The .30 Remington is a rimless version of the .30/30 or .30 WCF as it is generally known. It is designed for the Remington slide action and autoloading models of rifles and of the same family as the .25, .32, and .35 Remington. Some of the Remington Model 30 bolt actions have been built for this cartridge. It is an excellent little number, although not in the high-power class, and when used in the bolt-action rifle will permit of reasonable ballistics. In the "automatic" rifle, one must always

.30 Remington

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 22-in. Barrel	Breech Pressure	Recommended by
90	Lead	.234	Unique	8.0	1770		Her.
"	"	"	"	13.5	2380	32,000	"
"	"	.250	SR 80	7.5	1000		Du P.
"	"	"	"	11.5	1425		"
93	7.65 mm. Luger	.265	2400	12.0	1480		Her.
"	"	"	"	15.0	1900	15,000	"
"	"	"	"	18.0	2260	23,700	"
"	"	"	"	20.6	2535	32 000	"
"	"	"	"	23.0	2740	40,000	"
"	"	"	HiVel 3	18.0	1740		"
"	"	"	"	25.0	2460	23,400	"
"	"	"	"	30.6	3025	40,000	"
"	"	.250	SR 80	12.0	1520		Du P.
"	"	"	"	19.0	2130		"
"	"	.265	Unique	10.0	1845	17,600	Her.
"	"	"	"	13.2	2240	32,000	"
"	"	"	Lightn'g	14.0	1400		"
"	"	"	"	22.0	2120	19,000	"
"	"	"	"	29.7	2820	40,000	"
"	"	"	Sharpshooter	16.0	2060	16,300	"
"	"	"	"	22.2	2690	32,000	"
110	.30/30	.226	2400	12.0	1520		"
"	"	"	"	14.0	1725	14,200	"
"	"	"	"	16.0	1935	19 800	"
"	"	"	"	19.4	2200	32,000	"
"	"	"	"	21.3	2435	40,000	"
"	"	.229	HiVel 2	19.2	1525		"
"	"	"	"	29.0	2210	22,000	"
"	"	"	"	35.5	2760	40,000	"
"	"	"	HiVel 3	15.0	1400		"
"	"	"	"	27.0	2400	23,500	"
"	"	"	"	33.2	2920	40,000	"
"	"	"	Lightn'g	29.0	2600	33,900	"
"	"	"	Sharpshooter	27.3	2745	39,800	"
"	"	"	Unique	10.0	1735	19,500	"
"	"	"	"	13.4	2085	32,000	"
"	"	"	"	15.4	2300	41,400	"
"	"	.250	3031	32.0	2320		Du P.
"	"	"	"	36.5	2550		"
"	"	.225	17½	35.0	2360		"
"	"	"	"	37.0	2550		"
"	"	"	1204	20.0	2040		"
"	"	"	SR 80	13.0	1600		"
"	"	"	"	16.0	1880		"
"	"	.25	4198	21.0	1980		"
"	"	"	"	25.0	2350		"
120	Lead	.260	2400	16.0	1765	13,000	Her.
"	"	"	HiVel 3	15.0	1390		"
"	"	"	"	20.0	1780	13,000	"
"	"	"	SR 80	9.0	1025		Du P.
"	"	"	"	13.0	1420		"
"	"	"	Unique	8.0	1490	13,500	Her.
"	"	"	"	12.0	1920	28,000	"
"	"	"	Lightn'g	13.0	1350		"
"	"	"	"	22.0	1950	17,500	"
150	MC	.470	2400	14.0	1495		"
"	"	"	"	15.0	1565	15,200	"
150	MC	.470	2400	20.0	1940	26,000	Her.
"	"	"	"	22.1	2090	32,000	"
"	"	"	"	24.2	2250	40,000	"
"	"	"	HiVel 2	20.0	1450		"
"	"	"	"	26.0	1885	22,500	"
"	"	"	"	30.9	2300	40,000	"
"	"	"	HiVel 3	15.0	1300		"
"	"	"	"	23.0	2000	23,000	"
"	"	"	"	28.8	2400	40,000	"
"	"	"	Unique	9.0	1360	19,300	"
"	"	"	"	11.9	1685	32,000	"
"	"	"	Her.300	34.0	2355	40,500	"
"	"	"	Lightn'g	18.0	1500		"
"	"	"	"	23.0	1910	24,000	"
"	"	"	"	27.7	2300	40,000	"
"	"	"	Sharpshooter	14.0	1640	16,600	"
"	"	"	"	20.2	2145	32,000	"
"	Lead	.318	HiVel 3	13.0	1205		"
"	"	"	"	23.0	1950	25,000	"
"	"	.450	SR 80	10.0	1100		Du P.
"	"	"	"	14.0	1425		"
"	"	.318	Lightn'g	10.0	1180		Her.
"	"	"	"	20.0	1740	20,700	"
"	"	"	Sharpshooter	15.0	1750	19,800	"
"	"	"	"	19.2	2085	32,000	"
160	MC	.475	3031	24.0	1765		Du P.
"	"	"	"	30.5	2140		"
"	"	.500	SR 80	11.5	1180		"
"	"	"	"	14.0	1410		"
"	"	"	17½	28.1	1820		"
"	"	"	"	31.2	2050		"
"	"	"	1204	14.0	1650		"
"	"	"	18	28.0	1825[1]		"
"	"	"	"	30.4	2020[1]		"
"	"	"	Lightn'g	23.9	2000	33,500	Her.
"	"	"	HiVel 2	29.0	2160[1]	37,540	"
"	"	.475	21	27.0	2020[1]		Du P.
"	"	"	16	29.5	2020[1]		"
"	"	"	"	31.0	2140[1]		"
"	"	"	4198	18.0	1550		"
"	"	"	"	22.5	1965		"
"	GC	.500	SR 80	15.0	1540		"
169	"	.525	2400	11.0	1305		Her.
"	"	"	"	13.0	1490	15,000	"
"	"	"	"	16.0	1715	25,700	"
"	"	"	"	18.4	1940	32,000	"
"	"	"	"	20.1	2050	40,000	"
"	"	"	HiVel 3	13.0	1260		"
"	"	"	"	19.0	1730	22,500	"
"	"	"	"	25.0	2200	40,000	"
"	"	.405	Unique	8.0	1320	19,300	"
"	"	"	"	10.9	1600	32,000	"
"	"	"	Lightn'g	12.0	1165		"
"	"	"	"	1[illegible].0	1670	20,500	"
"	"	"	"	25.2	2165	40,000	"
"	"	"	Sharpshooter	12.0	1495	16,600	"
"	"	"	"	1[illegible].1	1935	32,000	"
170	SP	.489	2400	11.0	1200		"
"	"	"	"	14.0	1440	16,000	"
"	"	"	"	17.0	1675	21,500	"
"	"	"	"	20.8	1960	32,000	"
"	"	"	"	22.9	2105	40,000	"
"	"	"	HiVel 2	17.5	1290		"
"	"	"	"	26.0	1870	25,600	"
"	"	"	"	30.0	2175	40,000	"
"	"	"	HiVel 3	15.0	1320		"
"	"	"	"	22.0	1820	24,000	"
"	"	"	"	27.6	2230	40,000	"
"	"	"	Unique	[illegible].0	1185	18,200	"
"	"	"	"	11.2	1485	32,000	"
"	"	"	Her.300	31.0	2017[1]	34,000	"
"	"	.500	3031	2[illegible].0	1660		Du P.
"	"	"	"	30.0	2070		"
"	"	"	18	2[illegible].0	1700[1]		"
"	"	"	"	28.0	1815[1]		"
"	"	.489	Lightn'g	15.0	1780		Her.
"	"	"	"	21.0	1735	21,700	"
"	"	"	"	26.6	2165	40,000	"
"	"	"	Sharpshooter	13.[illegible]	1445	16,700	"
"	"	"	"	18.8	1895	32,000	"
"	"	.50	4198	18.0	1595		Du P.
"	"	"	"	22.0	1895		"
180	MC	"	Unique	11.9	1564	34,000	Her.
"	Lead	.466	"	4.0	1320	19,300	"
"	"	"	"	8.0	1600	32,000	"
195	"	.550	SR 80	10.0	1175		Du P.
"	"	"	"	13.0	1420		"

[1] Velocity with corrosive primer.

bear in mind that, with any autoloading cartridge, a certain type and weight of bullet at a given velocity are standard and must be more or less religiously duplicated in handloading. This is because autoloading or "automatic" types of action require a certain definite amount of energy in the cartridge to operate the mechanism. If loaded too heavily, there is liable to be serious damage to the gun; if loaded too lightly, jams and improper feeding are quite likely to occur. A wide variety of bullets is available in this, running from the 80-grain .32/20 open-point, up through to any of the Springfield class. Bullets heavier than 180 grains are not generally considered good performers in this cartridge. The twist of the Remington barrels is 1 turn in 12 inches.

.30 WCF (.30/30)

The .30/30 Winchester was one of the first successful medium-power small-caliber sporting-rifle cartridges. It was designed by the Winchester people for use in their Model 1894 repeater, a popular lever action which is made even today. The .30/30 cartridge was originally intended to be used with 30 grains of black powder, but the black powder and metal-jacketed soft-point bullets failed to get along very well together, and accordingly early loads were soon altered to handle smokeless powders.

This cartridge can be handloaded with reasonable success and a fair amount of accuracy. At one time Winchester turned out the Model 54 bolt-action repeater in this caliber, but it was a decided failure, chiefly because the man desiring a bolt action preferred to take one of the better and more powerful cartridges. However, in this particular caliber, the .30 WCF cartridge proved to be decidedly accurate. It is an extremely economical cartridge for reloading. A wide variety of .30 caliber bullets is available, and almost any of the medium-class smokeless powders can be used to excellent advantage. It handles mid-range charges fairly well, but owing to the capacity of the case light charges should not be loaded unless one desires to elevate the muzzle of his gun after every shot to put the powder in proper position in the cartridge case. The .30/30 probably has killed more game than any other single cartridge now being sold in the United States. Wherever English is spoken—and in a lot of other places—the old ".30/30" can be purchased or obtained in any one of several different makes of ammunition. Every major European factory loads this cartridge. Trading posts from one corner of the world to the other handle it. The cartridge should be loaded to a maximum pressure not exceeding 40,000 pounds.

.30 WCF

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
80	.32/20	.200	17½	35.0	2210		Du P.
"	"	.225	3031	37.0	2560		"
"	"	.200	SR 80	14.0	1855		"
"	"	"	"	16.0	1955		"
"	"	"	"	18.0	2120		"
90	Lead	.250	"	7.5	1050		"
"	"	"	"	11.5	1460		"
"	"	.234	Unique	8.0	1770		Her.
"	"	"	"	13.5	2380	32,000	"
93	7.65 mm. Luger	.265	2400	12.0	1480		"
"	"	"	"	15.0	1900	15,000	"
"	"	"	"	18.0	2260	23,700	"
"	"	"	"	20.6	2535	32,000	"
"	"	"	"	23.0	2740	40,000	"
"	"	"	HiVel 3	18.0	1740		"
"	"	"	"	25.0	2460	23,400	"
"	"	"	"	30.6	3025	40,000	"
"	"	.250	SR 80	12.0	1500		Du P.
"	"	"	"	19.0	2170		"
"	"	.265	Unique	10.0	1845	17,600	Her.
"	"	"	"	13.2	2240	32,000	"
"	"	"	Lightn'g	14.0	1400		"
"	"	"	"	22.0	2170	19,000	"
"	"	"	"	29.7	2820	40,000	"
"	"	"	Sharpshooter	16.0	2060	16,300	"
"	"	"	"	22.2	2090	32,000	"
110	MC	.229	2400	12.0	1520		"
"	"	"	"	14.0	1725	14,200	"
"	"	"	"	16.0	1935	19,800	"
"	"	"	"	19.4	2260	32,000	"
"	"	"	"	21.3	2435	40,000	"
"	"	"	HiVel 2	19.2	1525		"
"	"	"	"	29.0	2210	22,000	"
"	"	"	"	35.5	2760	40,000	"
"	"	"	HiVel 3	15.0	1400		"
"	"	"	"	27.0	2400	23,500	"
"	"	"	"	33.2	2970	40,000	"
"	"	"	Unique	10.0	1735	19,500	"
"	"	"	"	13.4	2085	32,000	"
"	"	"	"	15.4	2300[1]	41,000	"
"	"	"	Sharpshooter	27.3	2745	39,800	"
"	"	"	Lightn'g	29.0	2600	33,200	"
"	"	.250	3031	30.0	2150		Du P.
"	"	"	"	37.0	2580		"
"	"	"	17½	30.2	1935		"
"	"	"	"	39.0	2570		"
"	"	"	1204	27.0	2450		"
"	"	"	SR 80	12.0	1500		"
"	"	"	"	18.0	2055		"
"	"	"	18	35.0	2325[1]		"
"	"	"	"	39.5	2600[1]		"
"	"	.25	4198	24.0	2185[2]		"
"	"	"	"	32.5	2745[2]		"
115	.32/20 SP	.350	3031	30.0	2080		"
"	"	"	"	34.5	2370		"
"	"	"	17½	33.3	2290		"
"	"	"	"	35.9	2500		"
"	Lead	"	SR 80	11.5	1400		"
"	"	"	"	15.5	1830		"
120	"	.260	2400	16.0	1765	13,000	Her.
"	"	"	HiVel 3	15.0	1390		"
"	"	"	"	20.0	1780	13,000	"
"	"	"	Unique	8.0	1490	13,500	"
"	"	"	"	12.0	1920	2,800	"
"	"	"	SR 80	9.0	1060		Du P.
"	"	"	"	13.0	1460		"
"	"	"	Lightn'g	13.0	1350		Her.
"	"	"	"	22.0	1950	17,500	"
125	"	.275	SR 80	10.3	1260		Du P
"	"	"	"	12.2	1460		"
"	"	"	GR 75	6.5	1035[1]		"
"	"	"	"	8.0	1290[1]		"
"	"	"	"	10.0	1470[1]		"
"	"	"	Unique	7.0	1460		Her.
150	MC	.470	2400	14.0	1495		"
"	"	"	"	15.0	1565	15,200	"
"	"	"	"	20.0	1940	26,000	"
"	"	"	"	22.1	2090	32,000	"
"	"	"	"	24.2	2250	40,000	"
"	"	"	HiVel 2	20.0	1450		"
"	"	"	"	26.0	1885	22,500	"

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt Chg Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
150	MC	.470	HiVel 2	30.9	2300	40,000	Her.
"	"	"	"	31.8	2470[1]	41,500	"
"	"	"	HiVel 3	15.0	1300		"
"	"	"	"	23.0	2000	23,000	"
"	"	"	"	28.8	2460	40,000	"
"	"	"	Her 300	34.0	2355	40,000	"
"	"	"	Unique	9.0	1360	19,300	"
"	"	"	"	11.9	1685	32,000	"
"	"	300	3031	29.0	2040		Du P.
"	"	"	"	30.0	2120		"
"	"	"	"	35.0	2450		"
"	"	.350	17½	27.5	1990		"
"	"	"	"	34.8	2460		"
"	"	"	18	31.0	2160[1]		"
"	"	"	"	34.0	2350[1]		"
"	"	"	"	35.0	2400[1]		"
"	"	"	16	33.5	2360[1]		"
"	"	"	SR 80	14.0	1400		"
"	"	.470	Lightn'g	18.0	1500		Her.
"	"	"	"	23.0	1910	24,000	"
"	"	"	"	27.7	2300	40,000	"
"	"	"	Sharpshooter	14.0	1640	16,600	"
"	"	"	"	20.2	2145	32,000	"
"	"	.30	4198	23.0	2000		Du P.
"	"	"	"	27.0	2305		"
"	Lead	318	HiVel 3	13.0	1205		Her.
"	"	"	"	23.0	1950	25,000	"
"	"	.450	SR 80	10.0	1100		Du P.
"	"	"	"	14.0	1460		"
"	"	.318	Lightn'g	10.0	1180		Her.
"	"	"	"	20.0	1740	20,700	"
"	"	"	Sharpshooter	15.0	1750	19,800	"
"	"	"	"	19.2	2085	32,000	"
154	"	.450	SR 80	12.0	1260		Du P.
"	"	"	GR 75	11.8	1380[1]		"
"	"	"	Sharpshooter	12.5	1500		Her.
"	"	"	Unique	7.0	1352		"
160	MC	.500	SR 80	14.0	1410		Du P.
165	GC	"	"	15.0	1460		"
"	"	"	GR 75	17.0	1520[1]		"
"	"	"	Lightn'g	22.0	2005		Her.
169	"	.525	2400	11.0	1305		"
"	"	"	"	13.0	1490	15,000	"
"	"	"	"	16.0	1715	25,700	"
"	"	"	"	18.4	1940	32,000	"
"	"	"	"	20.1	2050	40,000	"
"	"	"	HiVel 3	13.0	1260		"
"	"	"	"	19.0	1730	22,500	"
"	"	"	"	25.0	2200	40,000	"
"	"	.405	Unique	8.0	1320	19,300	"
"	"	"	"	10.9	1600	32,000	"
"	"	"	Lightn'g	12.0	1160		"
"	"	"	"	18.0	1670	20,500	"
"	"	"	"	25.2	2165	40,000	"
"	"	"	Sharpshooter	12.0	1495	16,600	"
"	"	"	"	17.1	1935	32,000	"
170	SP	.489	2400	11.0	1200		"
"	"	"	"	14.0	1440	16,000	"
"	"	"	"	17.0	1675	21,500	"
"	"	"	"	20.8	1960	32,000	"
"	"	"	"	22.9	2105	40,000	"
"	"	"	HiVel 2	17.5	1290		"
"	"	"	"	26.0	1870	25,600	"
"	"	"	"	30.0	2175	40,000	"
"	"	"	HiVel 3	15.0	1320		"
"	"	"	"	22.0	1820	24,000	"
"	"	"	"	27.6	2230	40,000	"
"	"	"	Unique	8.0	1185	18,200	"
"	"	"	"	11.2	1485	32,000	"
"	"	"	Lightn'g	23.5	2005	35,500	"
"	"	"	Sharpshooter	10.8	1128	12,000	"
"	"	"	"	18.8	1895	32,000	"
"	"	"	"	20.3	2002	38,500	"
"	"	"	Her 300	32.0	2140[1]	36,000	"
"	"	"	Her. 308	29.1	2000[1]		"
"	"	.475	3031	28.0	1900		Du P.
"	"	"	"	33.5	2255		"
"	"	.500	17½	29.0	1960		"
"	"	"	"	34.3	2250		"
"	"	"	18	29.3	1970[1]		"
"	"	"	"	33.0	2185[1]		"
"	"	"	21	26.0	2000[1]		"
"	"	"	1204	17.0	1460		"
"	"	"	"	21.0	1755		"
"	"	"	16	28.2	1968		"
"	"	"	"	31.5	2185		"
"	"	"	"	33.0	2260		"
"	"	"	SR 80	11.0	1135		"
170	SP	.500	SR 80	15.0	1435		Du P.
"	"	.489	Lightn'g	15.0	1280		"
"	"	"	"	21.0	1735	21,700	"
"	"	"	"	26.6	2165	40,000	"
"	"	.475	4198	21.0	1835		"
"	"	"	"	26.0	2160		"
"	"	"	"	28.8	2312	Max.	PBS
"	Lead	.550	SR 80	10.0	990		Du P.
"	"	"	"	12.6	1260		"
"	"	"	GR 75	11.0	1374[1]		"
180	"	.466	Unique	4.0	800		Her.
"	"	"	"	8.0	1260	20,000	"
195	Lead BT	.550	SR 80	10.0	1160		Du P.
"	"	"	"	14.0	1420		"

[1] Velocity with corrosive primer.
[2] Velocity in 22-inch barrel.

.300 SAVAGE

The .300 Savage cartridge was an attempt by the Savage Arms Corporation to produce a .30-caliber high-power line, closely approaching the ballistics of the .30/06 Springfield. Their lever-action line, however, would not handle this particular length of cartridge case, so Savage drew up a .30 caliber with shorter dimensions, very similar to the .250 Savage and approximately the same overall length.

.300 Savage

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
74	32 Colt Auto	.175	SR 80	10.0	1260		Du P.
"	"	"	"	12.0	1430		"
80	.32/2 HP	.223	2400	16.0	2120		Her.
"	"	"	"	20.0	2300	17,000	"
"	"	"	"	26.0	2860	27,000	"
"	"	"	"	30.4	3160	39,000	"
"	"	"	"	34.2	3415	49,000	"
"	"	"	"	34.5	3480	49,700	"
"	"	"	HiVel 3	20.0	1880		"
"	"	"	"	32.0	2880	26,000	"
"	"	"	"	41.3	3650	49,000	"
"	"	"	Unique	10.0	2020		"
"	"	"	"	14.0	2380	21,500	"
"	"	"	"	15.0	2470	24,700	"
"	"	"	"	18.8	2800	39,000	"
"	"	"	"	21.2	3020	49,000	"
"	"	"	Lighcn'g	22.0	2020		"
"	"	"	"	32.0	2840	29,000	"
"	"	"	"	41.2	3580	49,000	"
"	"	"	Sharpshooter	16.0	2080		"
"	"	"	"	22.0	2610	21,000	"
"	"	"	"	25.0	2890	27,200	"
"	"	"	"	29.4	3265	39,000	"
"	"	"	"	32.7	3570	49,000	"
85	Lead	.213	Unique	5.0	1240		"
"	"	"	"	10.0	1875		"
"	"	"	"	15.0	2400	29,500	"
"	"	"	"	15.1	2405	30,000	"
90	"	.250	SR 80	14.0	1660		Du P.
"	"	"	"	15.5	1840		"
93	7.65-mm. Luger	.265	2400	14.0	1800		Her.
"	"	"	"	20.0	2260	18 600	"
"	"	"	"	24.0	2590	27 000	"
"	"	"	"	28.8	2955	39 000	"
"	"	"	"	32.4	3250	49.000	"
"	"	"	HiVel 3	21.0	1850		"
"	"	"	"	32.0	2780	29,300	"
"	"	"	"	40.5	3500	49,000	"
"	"	"	Unique	9.0	1770		"
"	"	"	"	13.0	2140	20,100	"
"	"	"	"	15.0	2330	27,000	"
"	"	"	"	18.0	2620	39,000	"

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
93	7.65 mm. Luger	.265	Unique	20.3	2835	49,000	Her.
"	"	"	Lightn'g	18.0	1700		"
"	"	"	"	29.0	2530	25,000	"
"	"	"	"	39.6	3320	49,000	"
"	"	"	Sharpshooter	15.0	1930		"
"	"	"	"	20.0	2350	19,300	"
"	"	"	"	24.0	2680	28,000	"
"	"	"	"	28.2	3025	39,000	"
"	"	"	"	31.8	3320	49,000	"
"	"	.300	3031	38.0	2385		Du P.
"	"	"	"	42.0	2660		"
"	"	.225	17½	42.0	2500		"
"	"	"	"	45.0	2750		"
"	"	.250	SR 80	11.0	1270		"
"	"	"	"	14.0	1600		"
110	.30/06 HP	.170	2400	15.0	1750		Her.
"	"	"	"	17.0	1900	16,600	"
"	"	"	"	23.0	2340	29,500	"
"	"	"	"	26.6	2600	39,000	"
"	"	"	"	30.2	2860	49,000	"
"	"	"	H Vel 2	17.0	1250		"
"	"	"	"	30.0	2190	20,800	"
"	"	"	"	42.8	3120	49,000	"
"	"	"	HiVel 3	18.0	1510		"
"	"	"	"	28.0	2350	23,500	"
"	"	"	"	38.1	3200	49,000	"
"	"	"	Lightn'g	18.0	1570		"
"	"	"	"	28.0	2310	25,200	"
"	"	"	"	38.1	3050	49,000	"
"	"	"	Sharpshooter	14.0	1680		"
"	"	"	"	19.0	2100	20,100	"
"	"	"	"	22.0	2340	26,400	"
"	"	"	"	26.8	2740	39,000	"
"	"	"	"	30.1	3010	49,000	"
"	"	.200	3031	40.0	2535		Du P.
"	"	"	"	40.5	2585		"
"	"	"	"	45.0	2915		"
"	"	.250	17½	42.0	2570		"
"	"	"	"	45.5	2890		"
"	"	"	1204	30.0	2500		"
"	"	"	15½	46.0	2570		"
"	"	"	SR 80	15.0	1570		"
"	"	"	"	18.0	1805		"
"	HP	"	16	41.0	2750[1]		"
"	"	"	"	42.5	2950[1]		"
"	"	.20	4198	29.5	2365		"
"	"	"	"	40.0	3045		"
"	"	"	4064	45.0	2680		"
115	Lead	.350	SR 80	12.7	1410		"
"	"	"	"	18.0	1830		"
120	WTCW	.250	3031	39.0	2440		"
"	"	"	"	44.0	2790		"
"	"	"	17½	43.0	2700		"
"	"	"	15½	46.0	2600		"
"	Lead	.320	Unique	9.0	1590		"
"	"	"	"	13.0	1940	24,700	"
125	"	.300	SR 80	9.5	1070		"
150	MC	.277	2400	13.0	1390		Her.
"	"	"	"	15.0	1535	16,000	"
"	"	"	"	21.0	1975	26,200	"
"	"	"	"	25.6	2295	39,000	"
"	"	"	"	27.8	2450	49,000	"
"	"	"	HiVel 2	20.0	1395		"
"	"	"	"	30.0	2080	25,000	"
"	"	"	"	39.2	2710	49,000	"
"	"	"	HiVel 3	16.0	1320		"
"	"	"	"	26.0	2070	24,500	"
"	"	"	"	35.1	2750	49,000	"
"	"	"	Lightn'g	15.0	1260		"
"	"	"	"	26.0	2010	25,500	"
"	"	"	"	35.7	2670	49,000	"
"	"	"	Sharpshooter	12.0	1330		"
"	"	"	"	16.0	1640	18,600	"
"	"	"	"	20.0	1950	26,500	"
"	"	"	"	25.2	2350	39,000	"
"	"	"	"	28.0	2570	49,000	"
"	"	"	Unique	10.0	1390		"
"	"	"	"	11.0	1475	20,800	"
"	"	"	"	14.0	1750	31,400	"
"	"	"	"	16.0	1900	39,000	"
"	"	"	"	18.3	2095	49,000	"
"	"	.40	4064	40.0	2335		Du P.
"	"	"	4198	28.0	2150		"
"	"	"	"	35.5	2600		"
"	"	.400	3031	37.0	2290		"
"	"	"	"	41.0	2565		"
"	"	.300	17½	40.0	2410		"
"	"	"	"	43.5	2625		"
"	"	.250	15½	46.0	2560		"
"	"	"	18	40.0	2360[1]		"

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
150	MC	.250	18	46.0	2750		Du P.
"	"	"	16	42.0	2600[1]		"
"	"	.300	1204	27.0	2155		"
"	"	.250	SR 80	18.0	1715		"
"	"	"	"	22.0	1990		"
"	Lead	.450	"	10.5	1120		"
"	"	"	"	14.5	1460		"
154	"	.262	2400	12.0	1430		Her.
"	"	"	"	16.0	1800	15,000	"
"	"	"	"	20.0	2130	21,800	"
"	"	"	H.Vel 3	10.0	1180		"
"	"	"	"	16.0	1460	8,400	"
"	"	"	"	22.0	1885	14,300	"
"	"	"	Unique	12.0	1850	21,900	"
"	"	"	Sharpshooter	14.0	1665		"
"	"	"	Lightn'g	17.0	1620	11,000	"
"	"	"	"	10.0	1060		"
"	"	"	"	24.0	2060	20,200	"
"	"	"	Sharpshooter	18.0	2000	18,400	"
169	GC	.525	2400	10.0	1135		"
"	"	"	"	20.0	1875	25,000	"
"	"	"	"	26.5	2300	49,000	"
"	"	"	HiVel 2	15.0	1100		"
"	"	"	"	29.0	1940	24,600	"
"	"	"	"	38.8	2545	49,000	"
"	"	"	Lightn'g	12.0	1050		"
"	"	"	"	24.0	1880	23,200	"
"	"	"	"	32.4	2480	49,000	"
170	.30/30	.465	2400	14.0	1420		"
"	"	"	"	20.0	1830	30,300	"
"	"	"	"	22.6	2005	39,000	"
"	"	"	"	25.0	2180	49,000	"
"	"	"	H.Vel 2	20.0	1340		"
"	"	"	"	29.6	2000	27,500	"
"	"	"	"	36.7	2490	49,000	"
"	"	"	H.Vel 3	18.0	1410		"
"	"	"	"	25.8	2000	27,200	"
"	"	"	"	32.1	2490	49,000	"
"	"	"	Lightn'g	15.0	1190		"
"	"	"	"	24.0	1820	22,500	"
"	"	"	"	32.3	2390	49,000	"
"	"	"	Sharpshooter	11.0	1190		"
"	"	"	"	16.0	1570	19,800	"
"	"	"	"	19.0	1800	26,400	"
"	"	"	"	23.6	2150	39,000	"
"	"	"	"	26.0	2330	49,000	"
"	"	"	Unique	7.0	1160		"
"	"	"	"	11.0	1455	22,400	"
"	"	"	"	12.0	1530	26,000	"
"	"	"	"	15.1	1755	39,000	"
"	"	"	"	17.2	1910	49,000	"
"	Lead	.500	"	13.1	1740	30,000	"
"	"	"	"	14.0	1790	33,800	"
173	Mark I	"	18	36.5	2185[1]		Du P.
"	"	"	"	38.0	2310[1]		"
180	MC	.450	15½	41.0	2210		"
"	"	"	HiVel 2	15.0	1060		Her.
"	"	"	"	26.0	1780	23,500	"
"	"	"	"	36.0	2430	49,000	"
"	"	"	HiVel 3	14.0	1160		"
"	"	"	"	23.0	1800	22,800	"
"	"	"	"	31.5	2420	49,000	"
"	"	.40	4198	27.0	2075		Du P.
"	"	"	"	34.0	2375		"
"	"	"	3031	34.0	2100		"
"	"	"	"	40.0	2450		"
"	"	"	4064	40.0	2285		"
195	Lead	.385	2400	9.0	1000		Her.
"	"	"	"	14.0	1380	15,300	"
"	"	"	"	19.0	1700	24,700	"
"	"	"	HiVel 3	10.0	920		"
"	"	"	"	15.0	1270	9,300	"
"	"	"	"	20.0	1630	18,600	"
"	"	"	Unique	12.4	1540	30,000	"
"	"	"	"	14.0	1620	36,700	"
"	"	"	Sharpshooter	16.0	1620	21,200	"
"	"	"	Lightn'g	11.0	1010		"
"	"	"	"	15.0	1290	12,000	"
"	"	"	"	19.0	1510	17,000	"

[1] Velocity with corrosive primer.

The .300 Savage is not generally considered a good cartridge for reloading. It has a very abrupt shoulder on the case, and after a few rounds this shoulder stretches badly and gives a considerable amount

of resizing trouble. With reasonable care and medium-power loading, however, cases stand up extremely well, and with proper full-length resizing dies it is possible to handle the cartridge case for at least 10 or 12 reloadings before it is necessary to discard it. Because of the capacity of the cartridge case, however, it is not possible to develop the ballistics of the Springfield, although they may be closely approached. It is extremely sensitive to changes in powder weight, and with a variation of ½ grain of charge, a far greater change in point of impact on the target is noted than with the same load in a Springfield cartridge. The .300 Savage cartridge is not only used in the lever-action Savage line, but also in their bolt-action model, and is a very fine performer in the latter type of gun in particular. Any of the Springfield bullets may be used to excellent advantage. Do not exceed 40,000 pounds maximum pressure when loading for the lever-action model or 50,000 pounds when loading for bolt-action.

.30/40 KRAG

This particular cartridge is known under a great many different names. It is frequently called the .30 Krag, the .30/40 Winchester, the .30 USA, and the .30 Army, but all these names refer to the same cartridge. The Krag cartridge is a rimmed type and is an excellent number for reloading. It was born for the several models of Krag rifles from 1893 to 1898. It was manufactured in huge quantities for issue as late as the World War. The Krag cartridge uses a long round-nosed bullet weighing 220 grains. Accordingly, the throats of Krag barrels are somewhat elongated to handle this bullet. Spitzer bullets do not perform at their best in long throats of this nature, but there are many custom-built rifles on the market today which have the barrels properly throated for the pointed bullet. Those who use the original Krag barrels will find that best results can be obtained by seating the bullets as far out of the cartridge case as possible. Frequently this will mean that the cartridge will be too long to operate through the magazine, but for single loading purposes it performs in an ideal manner.

The Krag rifle, with the Krag cartridge, has always been an accurate weapon. Despite the fact that in 1903 we adopted the Springfield rifle, it was not until around 1909 that the Krag rifle was abandoned for match shooting. At the National Matches each year, Krag rifles won over the Springfield, and it was found necessary to rule the Krag off the field by making it ineligible for competitive shooting. Of course, the Springfield today, with its highly developed cartridge, is not in the same class as the Springfield of 1909, and the Springfield will do a great many things that the Krag will not. The pressure limit of this cartridge and rifle is about 40,000 pounds. Winchester also adapted the Winchester Model 1895 for it, and this rifle is still on the market today—an extremely popular big-game gun. Any of the .30-caliber Springfield bullets will work well in the Krag rifle.

A word of warning to handloaders: Be sure to slug your barrel with a bullet of pure lead and measure it carefully. Krag barrels often vary tremendously in size, and the author has done much research at Springfield Armory to determine the reason for this variation, all without success. Krag barrels run from .306 up to .3125. The author has owned rifles having both of those barrel dimensions. The majority of them, however, run about .309. In loading for it, measure your bore first and then select the bullet that proves to be the best fit.

The cartridge is an easy one to reload; the cases last extremely well, and little resizing is necessary with normal loading. The Krag rifle, it must be clearly understood, is in the lever-action rifle class so far as maximum pressures are concerned. Do not load this much over a 42,000-pound pressure. Otherwise you are likely to invite disaster. All these rifles were manufactured before the days of heat-treating, and all receivers were case-hardened. With reasonable loads, however, the Krag is safe, and no bolt-action rifle manufactured either in the past or present has ever had the smoothness of operation of the old obsolete .30/40 Krag.

.30/40 Krag

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
80	.32/20	.207	2400	20.0	2100		Her.
"	"	"	"	25.0	2500	20,700	"
"	"	"	"	29.0	2825	24,500	"
"	"	"	"	32.4	3100	34,000	"
"	"	"	"	33.6	3200	42,000	"
"	"	"	HiVel 2	25.0	1750		"
"	"	"	"	36.0	2590	22,500	"
"	"	"	"	43.2	3160	42,000	"
"	"	"	HiVel 3	23.0	1860		"
"	"	"	"	32.0	2750	22,500	"
"	"	"	"	38.0	3320	42,000	"
"	"	"	Unique	12.0	2000		"
"	"	"	"	13.0	2100	17,600	"
"	"	"	"	16.0	2350	26,000	"
"	"	"	"	18.4	2685	34,000	"
"	"	"	"	20.5	2750	42,000	"
"	"	"	Lightning	20.0	1900		"
"	"	"	"	31.0	2680	26,500	"
"	"	"	"	38.0	3200	42,000	"
"	"	"	Sharpshooter	19.0	2220		"
"	"	"	"	22.0	2450	18,300	"
"	"	"	"	26.0	2760	26,600	"
"	"	"	"	28.8	2975	34,000	"
"	"	"	"	31.2	3160	42,000	"

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
80	.32/20	200	3031	42.0	2615		Du P.
"	"	"	"	47.0	2935		"
"	"	"	17½	45.0	2540		"
"	"	"	"	49.0	2875		"
"	"	"	SR 80	19.0	1960		"
"	"	"	"	23.0	2280		"
85	Mauser Auto.	.150	3031	42.0	2600		"
"	"	"	"	47.5	2890		"
"	"	"	SR 80	15.0	1720		"
"	"	"	"	23.0	2320		"
90	Lead	.250	"	10.0	1120		"
"	"	"	"	14.0	1400		"
93	7.65 mm. Luger	.265	HiVel 2	25.0	1850		Her.
"	"	"	"	34.0	2510	23,500	"
"	"	"	"	40.8	3030	42,000	"
"	"	"	Unique	10.0	1785		"
"	"	"	"	12.0	1980	18,700	"
"	"	"	"	16.2	2315	34,000	"
"	"	"	"	17.9	2450	42,000	"
"	"	.275	3031	40.0	2480		Du P.
"	"	"	"	45.5	2800		"
"	"	"	17½	40.0	2250		"
"	"	"	"	48.0	2850		"
"	"	"	SR 80	15.0	1540		"
"	"	"	"	17.0	1780		"
100	.32/20	.225	"	15.0	1670		"
"	"	"	"	20.0	1980		"
"	"	.250	3031	38.0	2400		"
"	"	"	"	45.5	2755		"
"	"	.225	17½	38.0	2125		"
"	"	"	"	48.0	2800		"
100	Lead	.235	HiVel 2	29.0	2120	15,200	Her.
"	"	"	Unique	8.0	1460	9,000	"
"	"	"	Sharpshooter	15.0	1760		"
"	"	.320	SR 80	10.0	1210		Du P.
"	"	"	"	12.5	1410		"
102	"	.250	"	10.5	1245		"
"	"	"	"	13.5	1500		"
110	.30/06	.165	2400	15.0	1650		Her.
"	"	"	"	16.0	1730	14,600	"
"	"	"	"	21.0	2110	25,500	"
"	"	"	"	24.0	2310	34,000	"
"	"	"	"	26.5	2495	42,000	"
"	"	"	HiVel 2	23.0	1650		"
"	"	"	"	33.0	2335	24,900	"
"	"	"	"	41.1	2890	42,000	"
"	"	"	HiVel 3	20.0	1720		"
"	"	"	"	29.0	2400	23,500	"
"	"	"	"	35.9	2920	42,000	"
"	"	"	Unique	8.0	1220		"
"	"	"	"	12.0	1645	19,100	"
"	"	"	"	16.4	2100	34,000	"
"	"	"	"	18.4	2270	42,000	"
"	"	"	Lightning	15.0	1345		"
"	"	"	"	28.0	2250	25,700	"
"	"	"	"	35.5	2780	42,000	"
"	"	"	Sharpshooter	15.0	1735		"
"	"	"	"	17.0	1900	15,800	"
"	"	"	"	22.0	2260	25,000	"
"	"	"	"	25.4	2505	34,000	"
"	"	"	"	27.9	2690	42,000	"
"	"	.200	3031	37.0	2250		Du P.
"	"	"	"	45.5	2800		"
"	"	"	17½	43.0	2500		"
"	"	"	"	50.0	3050		"
"	"	"	SR 80	18.0	1700		"
"	"	"	1204	25.5	2070		"
"	"	"	"	31.0	2360		"
"	"	.175	4198	28.0	2240		"
"	"	"	"	37.0	2740		"
"	"	"	4064	43.0	2490		"
"	"	"	"	47.5	2735		"
"	"	"	4320	42.0	2445		"
"	"	"	"	48.5	2795		"
115	.32/20	.367	HiVel 2	20.0	1330		Her.
"	"	"	"	30.0	2120	22,000	"
"	"	"	"	38.2	2765	42,000	"
"	"	"	HiVel 3	20.0	1750		"
"	"	"	"	29.0	2450	27,700	"
"	"	"	"	34.2	2830	42,000	"
"	"	"	Unique	11.0	1600	17,600	"
"	"	"	"	12.0	1675	20,500	"
"	"	"	"	15.8	2020	34,000	"
"	"	"	"	17.8	2140	42,000	"
"	"	.350	3031	35.0	2130		Du P.
"	"	"	"	43.0	2600		"
"	"	"	17½	40.0	2220		"
"	"	"	"	43.0	2420		"
"	"	"	SR 80	16.0	1630		"
"	"	"	"	20.0	1870		"

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
115	.32/20	.350	Her. 300	26.0	1400		Her.
"	Lead	.300	SR 80	10.5	1145		Du P.
"	"	"	"	16.0	1630		"
120	"	.353	HiVel 2	23.0	1665	12,600	Her.
"	"	"	Unique	11.0	1660	16,000	"
"	"	"	Sharpshooter	15.0	1655	13,000	"
"	"	.300	SR 80	13.5	1220		Du P.
"	"	"	"	17.5	1670		"
125	"	.375	"	13.5	1340		"
"	"	"	"	14.2	1400		"
"	"	"	GR 75	11.0	1380		"
"	"	"	Unique	6.7			Her.
150	30/06	.251	2400	14.0	1280		"
"	"	"	"	16.0	1540	14,200	"
"	"	"	"	21.0	1870	25,000	"
"	"	"	"	24.0	2050	34,000	"
"	"	"	"	26.0	2190	42,000	"
"	"	"	HiVel 2	15.0	960		"
"	"	"	"	31.0	2060	24,500	"
"	"	"	"	38.2	2530	42,000	"
"	"	"	HiVel 3	15.0	1180		"
"	"	"	"	27.0	2080	24,500	"
"	"	"	"	34.1	2580	42,000	"
"	"	"	Unique	12.0	1445	21,800	"
"	"	"	"	15.8	1725	34,000	"
"	"	"	"	17.8	1875	42,000	"
"	"	"	Lightning	20.0	1465		"
"	"	"	"	28.0	2040	25,000	"
"	"	"	"	33.6	2425	42,000	"
"	"	"	Sharpshooter	15.0	1545		"
"	"	"	"	18.0	1765	17,500	"
"	"	"	"	22.0	2135	26,000	"
"	"	"	"	24.8	2220	34,000	"
"	"	"	"	27.3	2370	42,000	"
"	"	"	Her. 300	47.0	2650[1]	40,000	"
"	"	"	Her. 308	42.0	2420[1]	40,000	"
"	"	.250	3031	35.0	2150		Du P
"	"	"	"	42.0	2515		"
"	"	"	17½	40.0	2245		"
"	"	"	"	47.3	2725		"
"	"	"	15½	49.0	2510		"
"	"	"	SR 80	12.5	1000		"
"	"	"	"	17.0	1420		"
"	"	"	1204	23.5	1620		"
"	"	"	"	29.0	2100		"
"	"	"	1147	41.0	2180		"
"	"	"	"	47.0	2575		"
"	"	"	16	45.5	2680[1]	42,300	"
"	"	"	18	38.0	2140[1]		"
"	"	"	"	43.0	2460[1]		"
"	"	"	"	44.5	2550[1]		"
"	"	"	GR 75	10.0	1020		"
"	"	"	"	14.0	1250		"
"	"	"	"	18.0	1480		"
"	"	"	"	21.0	1540		"
"	"	"	4198	25.0	1915		"
"	"	"	"	30.0	2225		"
"	"	"	4064	40.0	2375		"
"	"	"	"	46.0	2635		"
"	"	"	4320	36.0	2230		"
"	"	"	"	44.0	2540		"
"	Lead	.385	Unique	14.0	1680	28,400	Her.
"	"	.450	SR 80	11.0	1130		Du P
"	"	"	"	17.0	1480		"
154	"	.425	"	14.0	1330		"
"	"	"	GR 75	9.0	950		"
"	"	"	"	10.0	1220		"
"	"	"	"	11.0	1260		"
"	"	"	Unique	7.0	1170		Her
160	MC	.512	HiVel 2	15.0	880		"
"	"	"	"	29.0	1860	23,500	"
"	"	"	"	37.2	2420	42,000	"
169	GC Squibb	.525	2400	14.0	1340		"
"	"	.375	"	15.0	1450	17,000	"
"	"	.525	"	19.0	1685	23,500	"
"	"	.375	"	21.7	1930	34,000	"
"	"	.525	"	24.8	2060	42,000	"
"	"	.375	HiVel 2	14.0	990		"
"	"	"	"	28.0	1860	21,200	"
"	"	"	"	38.6	2425	42,000	"
"	"	"	HiVel 3	13.0	1120		"
"	"	"	"	24.0	1910	23,500	"
"	"	"	"	32.2	2385	42,000	"
"	"	"	Unique	6.0	1120		"
"	"	"	"	11.0	1400	21,500	"
"	"	"	"	14.8	1700	34,000	"
"	"	"	"	16.4	1765	42,000	"
"	"	"	Lightning	15.0	1295		"
"	"	"	"	24.0	1860	22,500	"
"	"	"	"	30.0	2180		"
"	"	"	"	31.9	2240	42,000	"

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
169	GC Squibb	375	Sharpshooter	12.0	1320		Her.
"	"	"	"	15.0	1545	16,200	"
"	"	"	"	18.0	1710	22,500	"
"	"	"	"	22.8	2100	34,000	"
"	"	"	"	24.2	2240	42,000	"
"	"	.325	SR 80	12.5	1170		Du P.
"	"	"	"	17.0	1475		"
"	"	"	"	18.0	1630		"
"	Lead "Squibb Miller"	"	"	10.5	1070		"
"	"	"	"	16.5	1475		"
170	.30 '30	.350	"	17.0	1380		"
"	"	"	18	36.0	1950		"
"	"	"	"	43.0	2310		"
"	"	"	16	41.0	2310		"
"	"	"	"	41.5	2400		"
"	"	"	17½	42.6	2310		"
"	"	"	Her. 300	42.5	2380	43,000	Her.
"	"	"	Unique	12.4	1430		"
"	Lead	.550	SR 80	13.8	1255		Du P.
"	"	"	GR 75	11.0	1200		"
173	9° BT	.460	2400	12.0	1070		Her.
"	"	"	"	19.0	1565	25,700	"
"	"	"	"	22.6	1825	34,000	"
"	"	"	"	25.2	2000	42,000	"
"	"	"	HiVel 2	25.0	1600		"
"	"	"	"	33.0	2110	33,700	"
"	"	"	"	36.2	2315	42,000	"
"	"	"	HiVel 3	18.0	1460		"
"	"	"	"	28.0	2070	32,700	"
"	"	"	"	31.2	2270	42,000	"
"	"	"	Unique	9.0	925		"
"	"	"	"	11.0	1125	21,000	"
"	"	"	"	13.0	1310	26,500	"
"	"	"	"	15.2	1520	34,000	"
"	"	"	"	17.4	1705	42,000	"
"	"	"	Lightning	20.0	1430		"
"	"	"	"	26.0	1825	26,500	"
"	"	"	"	32.0	2140	42,000	"
"	"	"	Sharpshooter	13.0	1310		"
"	"	"	"	15.0	1445	17,500	"
"	"	"	"	20.0	1755	26,500	"
"	"	"	"	23.2	2000	34,000	"
"	"	"	"	25.9	2130	42,000	"
"	"	"	Her. 300	43.0	2370[1]		"
"	"	"	Her. 308	40.0	2280[1]		"
"	"	.475	3031	32.0	1900		Du P.
"	"	"	"	34.0	2030		"
"	"	"	"	38.5	2330		"
"	"	"	17½	46.0	2525		"
"	"	"	1147	39.0	2100		"
"	"	"	"	43.5	2400		"
"	"	"	SR 80	17.0	1380		"
"	"	"	1204	22.0	1500		"
"	"	"	"	26.5	1850		"
"	"	"	4198	24.0	1780		"
"	"	"	"	27.5	2000		"
"	"	"	4064	34.0	1980		"
"	"	"	"	42.0	2430		"
"	"	"	4320	32.0	1870		"
"	"	"	"	40.0	2290		"
176	Lead "Gebhardt"	.300	SR 80	10.5	1030		"
"	"	"	"	16.5	1470		"
180	MC	.460	HiVel 2	22.0	1440		Her.
"	"	"	"	30.0	1950	27,500	"
"	"	"	"	36.0	2315	42,000	"
"	"	"	Her. 300	42.0	2360[1]	42,000	"
"	"	"	Her. 308	39.0	2250[1]	41,700	"
"	"	"	WA	39.0		Max.	"
"	"	"	Unique	13.0	1440		"
"	"	.375	1204	22.0	1480		Du P.
"	"	"	"	25.5	1780		"
"	"	.400	3031	33.0	1975		"
"	"	"	"	38.5	2230		"
"	BT MC	"	"	33.0	2000		"
"	"	"	"	38.5	2300		"
"	"	"	17½	45.0	2450		"
"	MC	"	"	37.4	2090		"
"	"	"	"	45.0	2450		"
"	"	"	1147	39.5	2140		"
"	"	"	"	44.0	2340		"
"	"	"	15½	43.4	2250		"
"	"	"	16	39.3	2380		"
"	BT MC	"	"	41.0	2380		"
"	MC	"	1204	22.0	1480		"
"	"	"	"	25.5	1780		"
"	BT MC	"	SR 80	17.0	1355		"
"	MC	"	"	17.0	1355		"
"	"	"	"	19.0	1500		"
"	"	"	4198	25.0	1710		"

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
180	MC	.400	4198	27.5	1920		Du P.
"	"	"	4064	36.0	2025		"
"	"	"	"	42.0	2360		"
"	"	"	4320	34.0	1910		"
"	"	"	"	40.0	2235		"
"	Lead	.537	HiVel 2	24.0	1530	15,600	Her.
"	"	"	Unique	10.0	1240	19,600	"
"	"	"	Sharpshooter	12.0	1225	12,900	"
"	"	.450	SR 80	12.0	980		Du P.
"	"	"	"	14.5	1760		"
1[illegible]	MC .303 Sav.	"	17½	40.0	2125		"
"	"	"	"	42.5	2300		"
"	"	"	Unique	11.9	1230	22,000	Her.
"	"	"	Her. 300	42.5	2260	42,000	"
"	"	"	18	37.0	1930		Du P.
"	"	"	16	41.0	2300		"
"	Lead	400	SR 80	12.5	1070		"
"	"	"	"	17.0	1380		"
195	"	.336	HiVel 2	22.0	1440	15,400	Her.
"	"	"	Unique	11.0	1300	20,400	"
"	"	"	Sharpshooter	13.0	1260	13,200	"
"	"	.450	SR 80	10.5	1045		Du P.
"	"	"	"	13.5	1245		"
197	"	.550	"	14.9	1220		"
207	GC	.611	2400	12.0	1100		Her.
"	"	"	"	14.0	1250	15,200	"
"	"	"	"	18.0	1510	24,200	"
"	"	"	"	21.0	1700	34,000	"
"	"	"	"	23.2	1825	42,000	"
"	"	"	HiVel 2	18.0	1250		"
"	"	"	"	27.0	1760	24,500	"
"	"	"	"	33.8	2130	42,000	"
"	"	"	HiVel 3	12.0	910		"
"	"	"	"	22.0	1660	22,000	"
"	"	"	"	29.6	2080	42,000	"
"	"	"	Unique	7.0	990		"
"	"	"	"	10.0	1200	21,200	"
"	"	"	"	11.0	1275	24,500	"
"	"	"	"	13.7	1455	34,000	"
"	"	"	"	15.7	1570	42,000	"
"	"	"	Sharpshooter	10.0	1145		"
"	"	"	"	14.0	1370	17,400	"
"	"	"	"	18.0	1620	25,700	"
"	"	"	"	21.0	1800	34,000	"
"	"	"	"	23.2	1910	42,000	"
"	"	"	Lightning	15.0	1200		"
"	"	"	"	22.0	1600	24,500	"
"	"	"	"	29.5	2020	42,000	"
"	"	.475	GR 75	14.0	1180[1]		Du P.
"	"	"	"	19.5	1380[1]		"
"	"	"	"	20.0	1420[1]		"
"	"	"	SR 80	20.0	1400		"
220	MC	.420	2400	12.0	900	14,500	Her.
"	"	"	"	18.0	1270	25,500	"
"	"	"	"	21.4	1500	34,000	"
"	"	"	"	23.5	1610	42,000	"
"	"	"	HiVel 2	18.0	1070		"
"	"	"	"	27.0	1580	33,700	"
"	"	"	"	34.5	2000	42,000	"
"	"	"	HiVel 3	13.0	960		"
"	"	"	"	23.0	1540	26,000	"
"	"	"	"	29.7	1920	42,000	"
"	"	"	Lightn'g	13.0	790		"
"	"	"	"	24.0	1500	26,000	"
"	"	"	"	30.9	2000	42,000	"
"	"	"	Sharpshooter	10.0	900		"
"	"	"	"	14.0	1140	18,100	"
"	"	"	"	17.0	1310	23,500	"
"	"	"	"	21.4	1575	34,000	"
"	"	"	"	23.9	1700	42,000	"
"	"	"	Unique	9.0	840		"
"	"	"	"	11.0	1000	21,500	"
"	"	"	"	12.0	1065	25,200	"
"	"	"	"	14.0	1200	34,000	"
"	"	"	"	15.6	1290	42,000	"
"	"	"	WA	35.0	1940[1]	38,000	"
"	"	"	"	36.2	2040[1]	42,000	"
"	"	"	Her. 300	40.3	2080[1]	42,000	"
"	"	"	Her. 308	37.0	1965[1]	42,000	"
"	MC Express	.425	3031	31.0	1710		Du P.
"	"	"	"	34.0	1870		"
"	"	"	"	37.0	2000		"
"	Lubaloy	.500	"	32.0	1780		"
"	"	"	"	35.0	1990		"
"	"	.450	17½	36.7	1880		"
"	"	"	"	41.6	2100		"
"	"	"	1147	36.5	1840		"
"	"	"	"	[illegible].0	2100		"

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
220	Lubaloy	.450	15½	34.3	1740		Du P.
"	"	"	"	40.4	2020		"
"	"	"	18	33.0	1750		"
"	"	"	"	39.0	2040	43,000	"
"	"	"	16	35.3	1880		"
"	"	"	"	40.0	2100	41,980	"
"	"	"	15	37.8	1880		"
"	"	"	"	40.0	2025		"
"	"	"	21	33.0	1885		"
"	"	"	Pyro	36.0	1960	42,000	"
"	"	"	SR 80	17.0	1250		"
"	"	.425	4198	25.0	1625		"
"	"	"	"	27.0	1755		"
"	"	"	4064	33.0	1775		"
"	"	"	"	41.0	2135		"
"	"	"	4320	31.0	1695		"
"	"	"	"	39.0	2055		"
230	Lead	.750	SR 80	12.8	900		"

[1] Velocity with corrosive primer.

.30/06 SPRINGFIELD

The .30/06 is probably the most highly specialized and extensively developed cartridge in the world. An entire book could be built around the subject of this particular cartridge, its possibilities and what has been done with it. Its history is decidedly interesting. The official name given to it by our armed forces is "Caliber .30, Model 1906, Mark I." It is a development extending over a period of more than thirty years of intensive research, and millions of dollars have been spent by the Government and commercial factories purely on the research end.

Around 1898 or '99 the United States Government began to see the necessity for greater power than was developed by the Krag rifle. Accordingly, its experts began their research, and found that in order to obtain that power, a different type of bolt-action mechanism was necessary. The German Mauser type was therefore adopted in an experimental form as the best possible bet. This Mauser rifle necessitated the use of a rimless cartridge case. There has been a great deal of argument among authors as to the origin of this rimless cartridge case. Essentially the forerunner of the Model 1906 cartridge was an experimental rimless Krag. This is correct, other authorities to the contrary notwithstanding. To the best of the author's knowledge, the only commercial rifle built for this experimental Government cartridge was the Blake. It was listed as the "New Army Rimless, caliber 30," in the Blake 1899 catalog. The rimless Krag, however, did not prove satisfactory and was never officially adopted. It proved an excellent basis for experimentation, but gave a maximum velocity of 2000 f.s. with the then existing practical smokeless powder—"W-A." Lightning was also used for experimental loads with a reasonable degree of success, but W-A proved to be the best number for this particular caliber. Around 1903, the Army decided that a greater velocity was necessary than 2000 f.s. Accordingly, the size of the cartridge case was increased, and thus was the Model 1903 cartridge born. This new Model 1903, officially adopted in that year, was a larger capacity cartridge case than the Krag or the rimless Krag. It had approximately the same length of neck. Velocity developed with W-A powder and the 220-grain Krag bullet was 2200 f.s. For a while this appeared to be an excellent idea, but the tremendously hot nitroglycerine powder made a useful barrel life of about 800 rounds, and the Ordnance boys foresaw a great deal of trouble if it was necessary to re-barrel their rifles every 800 shots. Accordingly, the velocity was dropped to 2000 f.s.—no better than the Krag. Thus the Model 1903 cartridge was officially 2000 f.s. as the 2200 f.s. loads were not used very extensively.

But the Ordnance Department heads were by no means satisfied. They wanted greater velocity. They decided that it was necessary to lighten the bullet to achieve this result. Accordingly they followed in the footsteps of Germany, borrowing from that country the idea of both cartridge case and rifle. A 150-grain bullet was born; a bullet of excellent shape, pointed, and with an excellent profile. At the same time they decided to shorten the neck of the case slightly, and this was done, the shorter neck offering sufficient support for the 150-grain bullet and not offering an excessive amount of bullet pull. All Model 1903 rifles were recalled from service and the barrels removed, replaced where necessary, and in other places where the barrel was in good condition it was rechambered and shortened slightly to handle the new cartridge case with a proper throat to handle the pointed bullet. Further information on this cartridge is contained in the chapter on powders, particularly references to "Pyro DG."

The cartridge has remained in the same identical shape from 1906 up to the present time. Shortly after the World War, however, the United States Army, again following the footsteps of the Germans, who employed a heavy boat-tail bullet during the later part of the war, began its own experiments with bullets of this type. Heavier flat-base types were used and a 170-grain bullet having a 6° tail. This proved a very excellent bullet for all purposes, but the Ordnance Department believed that a greater angle of boat-tail would be superior to the 6°. Accordingly, a 9° type was developed. This was officially adopted early in 1926 and was

known as the Mark I bullet. Ammunition loaded with this became known as Mark I ammunition. The 9° bullet, however, is somewhat heavier than the old 6° and is listed in the catalogs of many ammunition manufacturers as 172 grains. At Frankford Arsenal the official weight is 173 grains plus or minus 1.5 grains. Thus the permissible FA bullet weights are from 171.5 to 174.5 grains. All bullets that the author has checked coming from Frankford Arsenal come very close to the 173-grain mark, few, if any, varying as much as a grain.

The Mark I bullet was originally manufactured without a cannelure, but in recent years a cannelure has been knurled around the bearing surface, chiefly to permit crimping of the case mouth into the groove thus formed. Accuracy tests made at a great many laboratories show that the uncannelured bullets gave higher accuracy; but, unfortunately, these can no longer be obtained. The Springfield, however, can be loaded with this grooved Mark I bullet at any one of a number of velocities and give as fine accuracy as has ever been achieved with any centerfire rifle. With normal full-charge loading, it is suitable for target work at ranges up to 1200 yards. It has the widest variety of bullets available for any single caliber.

In 1937 there are 46 different factory loads available in this country. The normal groove diameter is .308 to .3085. Metal jacketed bullets measuring not over .309 can be used with full charges to good advantage, and if the powder charge is cut slightly, bullets measuring .3095 can be used with excellent success. Undersized bullets can also be shot, but one should take care to see that they are not below .307 if good results and freedom from gas cutting are desired. It is impossible to state what is the lightest-weight bullet that is practical. The lightest bullet the author has tried is the 74-grain .32 Colt automatic pistol bullet. With 52 grains of HiVel #2 a pressure of 41,000 pounds was developed, and a muzzle velocity of 3600 f.s. Accuracy was very poor. Dropping the charge down to 48 grains, however, gave groups of about 2 inches at 100 yards, sufficiently accurate for varmint shooting. Metal-case bullets of light weight, such as the .32/20/115 grain, make excellent killing loads, and these bullets can be used with a diameter as great as .311 or .312. For many years the author's favorite woodchuck load was the old-style 115-grain Winchester soft-point loaded to about 2000 f.s. with Du Pont #80 powder. The load was extremely accurate and at all ranges up to 100 yards would kill chucks cleanly and show tremendous wounding power.

The heaviest factory bullet in this caliber is the Peters 225-grain belted and the big Western Tool & Copper Works bullet of the same weight. This bullet can be driven up to 2400 f.s. with normal pressure. Maximum loading pressure for this Springfield cartridge for use in bolt-action guns is about 55,000 pounds. For practical purposes, however, hold all loads down to 50,000 pounds or below. Cartridge cases, due to the tremendous amount of money spent in experimental research, are made as fine as one could desire. The Ordnance Department took standard FA cases and reloaded them in an effort to determine life. A batch of 100 cases was reloaded 105 times with no failures. The author has one batch of assorted cases—10 of each commercial make—and the entire batch of 50 is intact with a single exception after more than 40 reloads; the single exception was caused through the buckling of a shell in improperly setting up a resizing die.

The Springfield rifle with the .30/06 cartridge makes the most practical all-round rifle in the world. Bullets can be purchased from the Frankford Arsenal of the brand-new Mark I type at a delivered cost of less than $8.00 per thousand, packing and shipping charges included. The cartridge can be loaded at sufficiently low power to make it ideal for indoor target work. It can be used as a squirrel rifle, a small-game rifle, a big-game rifle, and as a weapon capable of taking any of the heaviest game on the North American continent. This particular cartridge is the pet of the famous African hunter, Stewart Edward White. Today it is probably the most reloaded rifle cartridge in the United States. There is hardly a rifle club of any consequence that is not tooled up to reload it. If cases are used in one rifle and pressures are held below 50,000 pounds, neck sizing only will be necessary, particularly if the rifle is in good condition. After every 10 or 15 reloadings one may occasionally find it necessary to resize cases slightly. After about 20 reloads with some batches or brands it may be necessary to trim the cases to their original lengths. Others will last at least 50 loads without necessitating trimming. The .30/06 is the best all-round cartridge in the world today.

Since performance with corrosive and non-corrosive primers differs greatly, it is well that the handloader bear this in mind. Accordingly loads are tabulated below using the corrosive type (Frankford Arsenal #70), and below this the more modern non-corrosive types such as Winchester #120 and Remington #8½.

.30/06—Loads with Corrosive Primers

WARNING: All corrosive primer loads MUST be reduced 5% with non-corrosive primers!

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
74	32 Auto.	.165	2400	18.0	2010		Her.
"	"	"	"	25.0	2540	20,000	"
"	"	"	"	30.0	2900	26,500	"
"	"	"	"	38.6	3540	40,000	"
"	"	"	"	43.4	3880	51,000	"
"	"	"	Unique	9.0	1900	20,000	"
"	"	"	"	15.0	2400	27,500	"
"	"	"	"	22.0	2960	40,000	"
"	"	"	"	25.2	3220	51,000	"
"	"	"	Lightn'g	26.0	2200		"
"	"	"	"	48.0	3490	39,500	"
"	"	"	Sharpshooter	21.0	2420		"
"	"	"	"	37.0	3525	40,000	"
"	"	"	SR 80	10.0	1260		Du P.
"	"	"	"	27.0	2800		"
80	.32/20 MC	.224	2400	26.0	2500		Her.
"	"	"	"	30.0	2750	23,500	"
"	"	"	"	34.0	3000	27,500	"
"	"	"	"	40.2	3400	40,000	"
"	"	"	"	43.4	3600	51,000	"
"	"	"	HiVel 2	35.0	2280	20,000	"
"	"	"	"	53.0	3400	40,000	"
"	"	"	"	56.6	3620	51,000	"
"	"	"	HiVel 3	28.0	2240		"
"	"	"	"	39.5	3000	25,500	"
"	"	"	"	50.0	3680	42,000	"
"	"	"	Lightn'g	23.0	1950		"
"	"	"	"	45.0	3240	35,500	"
"	"	"	Sharpshooter	21.0	2300		"
"	"	"	"	23.0	2450	20,000	"
"	"	"	"	33.0	3180	32,000	"
"	"	"	"	37.4	3500	40,000	"
"	"	"	Unique	8.0	1710		"
"	"	"	"	15.0	2300	20,400	"
"	"	"	"	17.4	2500	30,000	"
"	"	"	"	21.8	2875	40,000	"
"	"	"	"	25.4	3170	51,000	"
"	"	.200	SR 80	29.0	2700		Du P.
"	"	"	17½	51.0	2875		"
"	"	"	"	57.0	3350		"
"	"	"	1204	15.0	1400		"
"	"	"	"	18.0	1800		"
"	"	.225	3031	51.0	2930		"
"	"	"	"	57.5	3275		"
90	Lead	.228	Unique	9.0	1600	8,000	Her.
"	"	"	Lightn'g	21.8	1775	9,000	"
"	"	.250	SR 80	9.5	1090		Du P.
"	"	"	"	13.5	1390		"
93	7.65 mm. Luger	.267	HiVel 2	33.0	2300	20,000	Her.
"	"	"	"	44.7	2900	28,500	"
"	"	"	"	54.8	3500	51,000	"
"	"	"	Unique	8.0	1560		"
"	"	"	"	12.0	1920	19,700	"
"	"	"	"	15.3	2200	25,500	"
"	"	"	"	21.6	2740	40,000	"
"	"	"	"	24.6	3000	51,000	"
"	"	.250	SR 80	13.5	1375		Du P.
"	"	"	"	17.0	1775		"
100	Lead	.375	Unique	9.0	1400	10,000	Her.
110	Hi-Speed	.175	3031	48.0	2750		Du P.
"	"	"	"	51.0	2960		"
"	"	"	"	57.5	3310		"
"	"	.225	1147	50.0	2640		"
"	"	"	"	56.0	3100		PBS
"	"	"	"	58.2	3200		"
"	"	"	"	62.0	3320		Du P.
"	"	"	15½	41.0	2360		"
"	"	"	"	60.0	3250		"
"	"	"	1204	29.0	2725		"
"	"	"	"	35.0	2600		"
"	"	"	SR 80	16.0	1650		"
"	"	"	"	26.6	2375		"
"	"	"	17½	37.0	2325		"
"	"	"	"	48.0	2825		"
"	"	"	"	56.0	3325		"
"	"	.175	4064	49.0	2745		"
"	"	"	"	59.0	3285		"
"	"	"	4320	52.0	2900		"
"	"	"	"	60.5	3345		"
"	"	"	4198	30.0	2330		"
"	"	"	"	45.5	3150		"
"	"	.171	HiVel 2	30.0	1980	20,000	Her.
"	"	"	"	43.0	2700	28,500	"
"	"	"	"	55.0	3360	51,000	"
"	"	"	HiVel 3	30.0	2330	24,000	"
"	"	"	"	41.0	2920	33,000	"
"	"	"	"	51.2	3475	51,000	"
"	"	"	Lightn'g	25.0	1910	21,000	"

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
110	Hi-Speed	.171	Lightn'g	37.0	2610	30,000	Her
"	"	"	"	39.6	3350	51,000	"
"	"	"	Sharpshooter	25.0	2440	26,000	"
"	"	"	"	32.0	2860	37,000	"
"	"	"	"	34.0	3000	40,000	"
"	"	"	"	38.7	3270	51,000	"
"	"	"	2400	29.0	2517		"
"	"	"	"	35.0	2881	40,500	"
"	"	"	"	39.8	3170	51,000	"
"	"	"	Unique	12.0	1700	22,400	"
"	"	"	"	18.0	2170	34,000	"
"	"	"	"	20.5	2375	40,000	"
"	"	"	"	23.7	2620	51,000	"
"	"	"	Her. 300	55.5	3250	44,000	"
111	GC	"	SR 80	8.0			HGL
"	"	"	"	10.0			"
"	"	"	"	12.0			"
115	.32/20	.355	HiVel 2	28.0	1900		Her.
"	"	"	"	41.3	2600	28,500	"
"	"	"	"	52.6	3180	51,000	"
"	"	"	Unique	6.0	1220		"
"	"	"	"	12.0	1695	21,000	"
"	"	"	"	14.8	1900	26,000	"
"	"	"	"	20.0	2320	40,000	"
"	"	"	"	22.8	2540	51,000	"
"	"	.350	3031	49.0	2745		Du P.
"	"	"	"	55.5	3040		"
"	"	"	17½	46.8	2590		"
"	"	"	"	52.0	2925		"
"	"	"	SR 80	19.5	1920		"
"	"	"	"	23.5	2180		"
"	Lead	.350	"	13.9	1350		"
120	WTCW	.248	HiVel 2	28.0	1820	20,000	Her.
"	"	"	"	45.0	2800	32,000	"
"	"	"	"	53.0	3260	51,000	"
"	"	.250	3031	46.0	2680		Du P.
"	"	"	"	56.0	3200		"
"	"	"	17½	46.0	2565		"
"	"	"	"	50.0	2995		"
"	"	"	"	56.0	3215		"
"	Lead	.300	SR 80	12.0	1275		"
"	"	"	"	18.0	1800		"
"	"	"	"	8.0			HGL
125	.30/30 Peters	.292	HiVel 2	28.0	1825		Her.
"	"	"	"	41.6	2600	26,500	"
"	"	"	"	53.2	3250	51,000	"
"	"	.300	3031	50.0	2835		Du P.
"	"	"	"	56.0	3130		"
"	"	"	17½	47.0	2600		"
"	"	"	"	50.0	2780		"
"	"	"	16	51.3	2970		PBS
"	Lead	.275	SR 80	13.4	1340		Du P.
"	"	"	"	13.7	1362		"
"	"	"	Unique	6.2	1270	8,300	Her.
140	"	.325	SR 80	10.5	1130		Du P.
"	"	"	Unique	7.0	1200		Her.
145	MC	"	1147	50.0	2630	34,000	PBS
"	"	"	"	52.0	2730	40,000	"
"	"	"	"	54.0	2830	46,000	"
150	"	.280	HiVel 2	30.0	1950	21,500	Her.
"	"	"	"	45.0	2730	36,000	"
"	"	"	"	51.4	3060	51,000	"
"	"	"	HiVel 3	27.0	2060	21,000	"
"	"	"	"	37.0	2550	33,000	"
"	"	"	"	47.0	3050	51,000	"
"	"	"	Lightn'g	25.0	1800	20,000	"
"	"	"	"	37.0	2470	30,000	"
"	"	"	"	46.0	2970	51,000	"
"	"	"	Sharpshooter	25.0	2205	25,500	"
"	"	"	"	30.0	2485	35,000	"
"	"	"	"	32.5	2625	40,000	"
"	"	"	"	37.0	2880	51,000	"
"	"	"	2400	20.0	1765		"
"	"	"	"	21.0	1820	20,000	"
"	"	"	"	30.0	2279	36,200	"
"	"	"	"	33.6	2560	40,000	"
"	"	"	"	36.8	2740	51,000	"
"	"	"	Unique	15.0	1760	28,000	"
"	"	"	"	20.0	2090	37,500	"
"	"	"	"	20.7	2130	40,000	"
"	"	"	"	23.8	2320	51,000	"
"	"	"	Her. 300	49.4	2700	45,000	"
"	"	"	"	53.0	3028	51,000	"
"	"	"	Her. 308	47.4	2700	49,000	"
"	"	"	3031	45.0	2500		Du P.
"	Old MC Serv.	.250	"	46.0	2565		"
"	"	"	"	54.0	3060		"
"	Bronze Pt.	"	"	46.0	2625		"
"	"	"	"	55.0	3065		"
"	"	.275	1147	50.5	2640		PBS
"	"	"	"	52.1	2700		Du P.

WARNING: All corrosive primer loads MUST be reduced 5% with non-corrosive primers!

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
.150	Bronze Pt.	.275	1147	52.3	2737		PBS
"	"	"	"	57.0	2840		"
"	"	"	"	58.5	3000		Du P.
"	"	"	1204	25.0	1850		"
"	"	"	"	31.0	2210		"
"	"	.250	17½	46.0	2575		"
"	"	"	"	54.4	3000		"
"	"	"	15½	51.0	2700		"
"	"	"	"	58.2	3030		"
"	"	"	SR 80	18.0	1550		"
"	"	"	"	19.0	1640		"
"	"	"	"	23.0	1940		"
"	"	"	16	46.0	2700		"
"	"	"	"	51.0	2950		"
"	"	"	18	42.0	2450		"
"	"	"	"	48.0	2700		"
"	"	"	"	51.5	2925		"
"	MC	"	15	51.4	2700		"
"	"	"	"	55.5	2950		"
"	"	"	21	45.7	2700		"
"	"	"	Pyro	48.5	2700	49,000	"
"	"	.25	4064	46.0	2525		"
"	"	"	"	57.0	3070		"
"	"	"	4320	48.0	2600		"
"	"	"	"	57.5	3080		"
"	"	"	4198	27.0	1985		"
"	"	"	"	43.0	2820		"
"	Lead	.438	Sharp-shooter	14.6	1500	11,200	Her.
"	"	"	Unique	11.4	1500	20,500	"
"	"	.450	SR 80	12.5	1265		Du P.
"	"	"	"	18.0	1680		"
154	"	.425	"	13.5	1275		"
"	"	"	Unique	9.0	1410		Her.
165	.30/30	"	16	40.0	2309	31,300	PBS
"	"	"	"	45.0	2546	40,260	"
169	GC "Squibb"	.375	HiVel 2	25.0	1650		Her.
"	"	"	"	35.0	2120	26,000	"
"	"	"	"	45.0	2595	40,500	"
"	"	"	HiVel 3	20.0	1625		"
"	"	"	"	30.0	2140	25,600	"
"	"	"	"	39.0	2600	44,300	"
"	"	"	Lightn'g	20.0	1580		"
"	"	"	"	30.0	2080	27,300	"
"	"	"	"	39.0	2540	41,200	"
"	"	"	Sharp-shooter	15.0	1540		"
"	"	"	"	20.0	1850	20,000	"
"	"	"	"	24.0	2075	26,500	"
"	"	"	"	30.6	2420	40,000	"
"	"	"	"	31.0	2440	40,800	"
"	"	.525	2400	16.0	1520		"
"	"	.375	"	20.0	1740	20,000	"
"	"	.525	"	23.0	1900	24,000	"
"	"	"	"	31.6	2365		"
"	"	.375	"	32.0	2380	39,600	"
"	"	"	Unique	10.0	1340	21,000	"
"	"	"	"	17.0	1815	32,500	"
"	"	"	"	19.3	1940	40,000	"
"	"	"	"	22.3	2700	51,000	"
"	"	.275	SR 80	12.0	1185		Du P.
"	"	"	"	18.0			HGL
"	"	"	"	20.0	1730		Du P.
"	"	"	"	24.0			HGL
"	"	"	Pistol 5	12.0			"
"	"	425	1204	15.0	1400		Du P.
"	Lead "Squibb Miller"	.250	SR 80	12.0	1160		"
"	"	"	"	20.0	1695		"
170	.30/30	.480	HiVel 2	28.0	1735		Her.
"	"	"	"	37.2	2200	26,500	"
"	"	"	"	49.4	2800	51,000	"
"	"	.450	3031	46.0	2530		Du P.
"	"	"	"	52.5	2750		"
"	"	.250	17½	40.0	2390		"
"	"	"	"	52.0	2740		"
"	"	"	SR 80	15.0	1300		"
"	"	"	"	17.0	1500		"
"	"	"	"	22.0	1750		"
"	"	"	18	48.0	2490		"
"	"	"	"	50.0	2620		"
"	"	"	"	53.0	2730		"
"	"	"	16	45.0	2600		"
"	"	"	"	48.0	2700		"
"	"	"	GR 75	14.0	1350		"
"	"	"	15½	54.0	2700		"
"	"	"	1147	52.0	2700		"
"	"	"	"	54.0	2800		"
"	"	"	4198	28.8	2212	37,600	PBS
172	WTCW	.475	15½	44.5	2250		Du P.
"	"	"	"	53.0	2650		"
"	"	"	"	53.5	2700	47,000	JBS
"	"	"	17½	39.0	2130		Du P.

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
172	WTCW	.475	17½	51.5	2700		Du P.
"	"	"	1147	46.5	2400		"
"	"	"	"	54.0	2720		"
"	"	"	16	44.0	2400		"
"	"	"	"	46.5	2650		"
173	9° BT	"	2400	23.0	1790	25,000	Her.
"	"	"	"	25.0	1900	28,000	"
"	"	"	"	30.0	2170	36,700	"
"	"	"	"	31.4	2255	40,000	"
"	"	"	"	34.6	2425	51,000	"
"	"	"	HiVel 2	25.0	1610		"
"	"	"	"	36.4	2200	28,500	"
"	"	"	"	49.0	2830	51,000	"
"	"	"	HiVel 3	25.0	1860	18,000	"
"	"	"	"	35.0	2355	33,000	"
"	"	"	"	42.7	2740	51,000	"
"	"	"	Unique	14.0	1405	26,500	"
"	"	"	"	15.0	1475	28,000	"
"	"	"	"	19.0	1760	39,000	"
"	"	"	"	19.3	1785	40,000	"
"	"	"	"	22.2	1985	51,000	"
"	"	"	Lightn'g	17.0	1345		"
"	"	"	"	31.0	2070	27,000	"
"	"	"	"	44.6	2785	51,000	"
"	"	"	Sharp-shooter	20.0	1795	24,500	"
"	"	"	"	30.0	2360	38,200	"
"	"	"	"	30.7	2400	40,000	"
"	"	"	"	35.2	2650	51,000	"
"	"	"	Her. 300	49.6	2700	52,000	"
"	"	"	"	50.0	2760	53,000	"
"	"	"	Her. 308	47.3	2550		"
"	"	.450	3031	38.8	2260	29,300	PBS
"	"	"	"	40.0	2340		Du P.
"	"	"	"	48.5	2800		"
"	"	.475	17½	39.0	2200		"
"	"	"	"	45.5	2500		"
"	"	"	"	51.0	2800		"
"	"	"	15½	52.0	2685		"
"	"	"	"	53.5	2810		"
"	"	"	1147	36.0	1940		PBS
"	"	"	"	38.0	2000		"
"	"	"	"	40.0	2090		"
"	"	"	"	42.0	2200		"
"	"	"	"	44.0	2280		"
"	"	"	"	46.0	2390		"
"	"	"	"	48.0	2488		"
"	"	"	"	50.0	2580		"
"	"	"	"	50.5	2595		Du P.
"	"	"	"	52.0	2680		PBS
"	"	"	"	54.0	2780		"
"	"	"	"	54.5	2800	51,000	Du P.
"	"	"	1204	22.5	1650		"
"	"	"	"	29.0	2025		"
"	"	"	SR 80	17.0	1500		"
"	"	"	"	22.0	1765		"
"	"	"	4198	33.0	2260	34,000	PBS
"	"	"	"	37.0	2453	42,000	"
"	"	"	"	39.8	2575	50,000	"
"	"	"	4064	41.0	2275	29,000	"
"	"	"	"	50.4	2716	45,300	"
"	"	"	"	52.0	2825	51,000	"
"	"	"	18	38.0	2150		Du P.
"	"	"	"	46.0	2550		"
"	"	"	"	50.0	2765		"
"	"	"	16	45.0	2600		"
"	"	"	"	48.1	2750	53,000	"
"	"	"	Pyro	46.0	2500	49,000	"
"	"	"	15	52.5	2700		"
"	"	"	17	37.0	2 80	32,000	PBS
"	"	"	"	40.0	2310	33,600	"
"	"	"	"	45.0	2550	40,700	"
"	"	"	4064	43.0	2415		Du P.
"	"	"	"	51.0	2820		"
"	"	"	4320	45.0	2480		"
"	"	"	"	51.0	2860		"
"	"	"	4198	25.0	1830		"
"	"	"	"	39.5	2615		"
176	Lead "Gebhard"	.300	SR 80	12.0			"
"	"	"	"	20.0			"
180	BT	.472	HiVel 2	23.0	1600		Her.
"	"	"	"	35.6	2200	31,000	"
"	"	"	"	47.6	2780	51,000	"
"	"	.450	3031	41.0	2325		Du P.
"	"	"	"	42.0	2405		"
"	"	"	"	50.0	2790		"
"	"	.375	17½	46.5	2500		"
"	"	"	"	50.5	2730		"
"	"	"	15½	50.5	2590		"
"	"	"	"	53.7	2725		"
"	"	"	1147	46.0	2320		"
"	"	"	"	54.5	2740		"

WARNING: All corrosive primer loads MUST be reduced 5% with non-corrosive primers!

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
180	BT	.375	SR 80	18.0	1375		Du P.
"	"	"	15	52.5	2680	48,083	"
"	"	"	16	47.5	2650	49,950	"
"	"	"	"	48.0	2661	50,030	"
"	"	"	4064	43.0	2350		"
"	"	"	"	53 0	2765		"
"	"	"	4320	45.0	2380		"
"	"	"	"	53.5	2785		"
"	"	"	4 98	26.0	1810		"
"	"	"	"	41.0	2560		"
"	MC	"	17½	45.0	2425		"
"	"	"	"	50.0	2690		"
"	"	"	15½	48.0	2400		"
"	"	"	"	53.1	2650		"
"	"	"	"	53.6	2710		"
"	"	"	1147	44.7	2250	32,260	PBS
"	"	"	"	46.0	2340	33,180	"
"	"	"	"	47.3	2375	34,660	"
"	"	"	"	49.2	2450	38,520	"
"	"	"	"	51.5	2553	43,540	"
"	"	"	"	53 5	2650	46,840	"
"	"	"	"	54.0	2690		Du P.
"	"	"	"	54.5	2725		"
"	"	"	1204	21.0	1450		"
"	"	"	"	29.0	2000		"
"	"	"	SR 80	18.0	1375		"
"	"	"	16	46.5	2600		"
"	"	"	15	51.5	2650	46,516	"
"	"	"	Her. 308	46.0	2460		Her.
"	"	"	Her. 300	50.0	2680	52,200	"
"	"	"	Her. WA	47.5			"
"	"	"	HiVel 2	46.0	2726	52,000	"
"	"	"	4064	51.7	2678	47,000	PBS
"	Lead	.468	Unique	14.6	1600	31,600	Her.
	"	.475	SR 80	17.0	1500		Du P.
193	Lead BT	.450	"	12.0	1150		"
"	"	"	"	16.0	1425		"
196	GC	.425	"	23.0	1700		"
"	"	"	1204	15.0	1300		"
200	WTCW	.400	HiVel 2	26.0	1650	20,000	Her.
"	"	"	"	37.8	2200	33,400	"
"	"	"	"	45.6	2560	51,000	"
"	"	.375	3031	40.0	2190		Du P.
"	"	"	"	47.0	2490		"
"	"	"	17½	45.0	2385	45 000	PBS
"	"	"	"	47.0	2475	52,000	"
"	"	"	15½	50.0	2500		JRS
207	GC	.464	H.Vel 2	28.0	1780		Her.
"	"	"	"	36.0	2100	30,600	"
"	"	"	"	45.6	2480	51,000	"
"	"	"	HiVel 3	23.0	1710		"
"	"	"	"	30.0	2000	29.700	"
"	"	"	"	38.4	2330	51,000	"
"	"	"	Lightn'g	20.0	1485		"
"	"	"	"	30.0	1970	28,300	"
"	"	"	"	41.2	2420	51,000	"
"	"	"	Sharpshooter	15.0	1420		"
"	"	"	"	25.0	1970	34,500	"
"	"	"	"	27.4	2075	40,000	"
"	"	"	"	32.0	2255	51,000	"
"	"	"	2400	22.0	1750		"
"	"	"	"	26.0	1920	34,200	"
"	"	"	"	28.1	2005	40,000	"
"	"	"	"	32.0	2180	51,000	"
"	"	"	Unique	11.0	1270	22,600	"
"	"	"	"	15.0	1530	29,500	"
"	"	"	"	18.5	1730	40,000	"
"	"	"	"	21.4	1885	51,000	"
"	"	"	GR 75	15.0	1220		Du P.
"	"	"	"	17.0	1400		"
"	"	"	"	18.0	1435		"
220	MC	.441	HiVel 2	23.0	1400	20,000	Her.
"	"	"	"	35 8	2000	30,000	"
"	"	"	"	44.5	2415	51,000	"
"	"	"	HiVel 3	21.0	1500	20,000	"
"	"	"	"	31.4	2000	32,000	"
"	"	"	"	39.2	2345	51,000	"
"	"	"	Lightn'g	16.0	1210		"
"	"	"	"	32 8	2000	31,000	"
"	"	"	"	41.6	2410	51,000	"
"	"	"	Sharpshooter	14.0	1300		"
"	"	"	"	18.0	1500	21,400	"
"	"	"	"	24.0	1800	30,500	"
"	"	"	"	28.4	2020	40,000	"
"	"	"	"	32.6	2230	51,000	"
"	"	"	2400	14.0	1180		"
"	"	"	"	18.0	1380	20,500	"
"	"	"	"	22.3	1600	26,000	"
"	"	"	"	29.6	1965	40,000	"
"	"	"	"	33.6	2170	51,000	"
"	"	"	Unique	11.0	1165	22,500	"
220	MC	.441	Unique	17 0	1500	33,000	Her.
"	"	"	"	18.9	1620	40 000	"
"	"	"	"	21.4	1770	51 000	"
"	"	"	Her. 300	46.0	2247	52 000	"
"	"	"	"	47.0	2358	54 200	"
"	"	"	Her. 308	45.0	2175	50,000	"
"	"	.450	3031	39.0	2040		Du P.
"	"	"	"	42.0	2160		"
"	"	"	"	47.5	2380		"
"	"	"	"	48.0	2400		"
"	MC BT	.500	"	38 0	2060		"
"	"	"	"	44.0	2325		"
"	MC	.475	17½	42.0	2110		"
"	"	"	"	48.0	2350		"
"	"	"	15½	43.4	2060		"
"	"	"	"	46.0	2165		"
"	"	"	"	48.5	2310		"
"	"	"	"	52 0	2455		"
"	"	"	1147	43.0	2075		"
"	"	"	"	50.0	2370		"
"	"	"	18	44.5	2200		"
"	"	"	"	46.5	2350	51,000	"
"	"	"	16	43.0	2225	44.000	"
"	"	"	"	45.0	2350	51,950	"
"	"	"	15	47.2	2250		"
"	"	"	Pyro	43.0	2200		"
"	"	"	SR 80	18.0	1250	31,340	PBS
"	"	.45	4064	41.0	2100		Du P.
"	"	"	"	49.0	2400		"
"	"	"	4320	42.0	2115		"
"	"	"	"	49.0	2425		"
230	Lead	.500	HiVel 2	22 0	1470	19,408	Her.
"	"	"	HiVel 3	18.0	1370	15,600	"
"	"	"	Lightn'g	18.0	1335	27,500	"
"	"	"	Sharpshooter	18.5	1550	23 700	"
"	"	"	2400	14.0	1225	12,000	"
"	"	"	"	19.0	1535	33 000	"
"	"	"	Unique	16.3	1490	40 000	"
"	"	"	"	16.4	1500	40,500	"

.30/06—Loads with Non-Corrosive Primers

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
74	.32 ACP	.165	HiVel 2	36.0	2455		Her.
"	"	"	"	44.0	3040	25,500	"
"	"	"	"	52 0	3595	41,000	"
"	"	"	HiVel 3	34 0	2575		"
"	"	"	"	40.0	3005	22,300	"
"	"	"	"	47.0	3500	41 300	"
"	"	"	Lightn g	30.0	2545		"
"	"	"	"	35 0	2885	23 200	"
"	"	"	"	40.0	3195	33 500	"
"	"	"	Sharpshooter	30.0	3050	26 000	"
"	"	"	"	34.8	3405	40 000	"
"	"	"	2400	25 0	2705	22 300	"
"	"	"	"	31 0	3160	40 000	"
"	"	"	Unique	16 0	2475	19,000	"
"	"	"	"	20 0	2830	34 300	"
80	.32/20 HP	.224	HiVel 2	36 0	2440		"
"	"	"	"	44 0	3015	27 500	"
"	"	"	"	50.5	3400	40,000	"
"	"	"	HiVel 3	34 0	2575		"
"	"	"	"	40 0	3035	26.700	"
"	"	"	"	46.0	3415	39,300	"
"	"	"	Lightn'g	30 0	2550		"
"	"	"	"	40.0	3210	37,000	"
"	"	"	"	45.2	3510	51,000	"
"	"	"	Sharpshooter	27 0	2810	21,000	"
"	"	"	"	33 5	3335	40,000	"
"	"	"	2400	24 0	2595	20,000	"
"	"	"	"	31 6	3110	40,000	"
"	"	"	Unique	17 0	2495	25,500	"
"	"	"	"	21.4	2860	40,000	"
93	.30 Luger	.267	HiVel 2	35.0	2400		"
"	"	"	"	40.0	2725	23,000	"
"	"	"	"	46.0	3120	34,500	"
"	"	"	HiVel 3	32.0	2420		"
"	"	"	"	37 0	2760	23.400	"
"	"	"	"	42 0	3100	33,000	"
"	"	"	2400	23.0	2420	19,600	"
"	"	"	"	29.6	2930	40,000	"

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
93	.30 Luger	.267	Unique	15.0	2200	19,300	Her.
"	"	"	"	20.9	2675	40,000	"
110	MC	.171	HiVel 2	35.0	2315		"
"	"	"	"	42.0	2735	29,000	"
"	"	"	"	49.8	3280	51,000	"
"	"	"	HiVel 3	32.0	2320		"
"	"	"	"	40.0	2860	31,600	"
"	"	"	"	47.0	3320	51,000	"
"	"	"	Lightn'g	28.0	2195		"
"	"	"	"	36.0	2720	32,700	"
"	"	"	"	42.6	3125	51,000	"
"	"	"	Sharpshooter	22.0	2230	20,000	"
"	"	"	"	32.2	2910	40,000	"
"	"	"	2400	22.0	2160	22,000	"
"	"	"	"	29.0	2600	40,000	"
"	"	"	Unique	15.0	1960	22 000	"
"	"	"	"	19.8	2320	40,000	"
115	.32/20 MC	.355	HiVel 2	33.0	2190		"
"	"	"	"	37.0	2440	22,900	"
"	"	"	"	40.0	2660	29,500	"
"	"	"	HiVel 3	30.0	2200		"
"	"	"	"	35.0	2530	25,000	"
"	"	"	"	39.0	2660	33,500	"
"	"	"	Lightn'g	25.0	2020		"
"	"	"	"	29.0	2260	19,300	"
"	"	"	"	33.0	2535	29,000	"
"	"	"	2400	20.0	2015	16,500	"
"	"	"	"	27.0	2490	36,000	"
"	"	"	Unique	14.0	1865	20,000	"
"	"	"	"	19.3	2295	40,000	"
120	MC	.248	HiVel 2	36.0	2310		"
"	"	"	"	42.0	2690	29,300	"
"	"	"	"	49.6	3200	51,000	"
"	"	"	HiVel 3	32.0	2280		"
"	"	"	"	40.0	2805	32,000	"
"	"	"	"	46.2	3220	51,000	"
"	"	"	Unique	14.0	1800	18,700	"
"	"	"	"	20.5	2300	40,000	"
125	.30/30 MC	.292	HiVel 2	30.0	1920		"
"	"	"	"	40.0	2540	25,500	"
"	"	"	"	50.1	3200	51,000	"
"	"	"	HiVel 3	28.0	2010		"
"	"	"	"	38.0	2675	28,500	"
"	"	"	"	46.8	3160	51,000	"
"	"	"	Lightn'g	25.0	1970		"
"	"	"	"	35.0	2610	30,000	"
"	"	"	"	43.0	3060	51,000	"
"	"	"	2400	20.0	1950	18,500	"
"	"	"	"	29.4	2595	40,000	"
150	MC	.240	HiVel 2	32.0	1995		"
"	"	"	"	42.0	2610	33,700	"
"	"	"	"	48.6	2980	51,000	"
"	"	"	HiVel 3	27.0	1855		"
"	"	"	"	37.0	2495	31,500	"
"	"	"	"	43.4	2980	51,000	"
"	"	"	Lightn'g	27.0	1960		"
"	"	"	"	35.0	2475	33,700	"
"	"	"	"	40.8	2800	51,000	"
"	"	"	2400	22.0	1940	24,000	"
"	"	"	"	27.2	2270	40,000	"
"	"	"	Sharpshooter	24.0	2140	24,800	"
"	"	"	"	30.8	2540	40,000	"
"	"	"	Unique	14.0	1640	21,300	"
"	"	"	"	19.5	2010	40,000	"
169	GC	.375	HiVel 2	30.0	1925		"
"	"	"	"	40.0	2440	35,000	"
"	"	"	"	46.2	2760	51,000	"
"	"	"	HiVel 3	24.0	1740		"
"	"	"	"	30.0	2040	23,200	"
"	"	"	"	35.0	2340	33,200	"
"	"	"	Lightn'g	20.0	1605		"
"	"	"	"	28.0	2030	26,600	"
"	"	"	"	32.0	2225	34,000	"
"	"	"	Sharpshooter	19.0	1800	19,500	"
"	"	"	"	28.6	2320	40,000	"
"	"	"	2400	19.0	1745	20,000	"
"	"	"	"	26.4	2180	40,000	"
"	"	"	Unique	12.0	1500	19,500	"
"	"	"	"	17.8	1890	40,000	"
170	.30/30	.480	HiVel 2	30.0	1850		"
"	"	"	"	40.0	2420	36,200	"
"	"	"	"	46.0	2720	51,000	"
"	"	"	HiVel 3	28.0	1900		"
"	"	"	"	36.0	2340	34,000	"
"	"	"	"	43.4	2705	51,000	"
"	"	"	Lightn'g	25.0	1740		"
"	"	"	"	32.0	2175	31,300	"
"	"	"	"	39.8	2595	51,000	"
"	"	"	Sharpshooter	20.0	1760	21,500	"

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
170	.30/30	.480	Sharpshooter	28.8	2275	40,000	Her.
"	"	"	2400	20.0	1700	21 500	"
"	"	"	"	27.0	2075	40 000	"
"	"	"	Unique	14.0	1490	22 000	"
"	"	"	"	18.5	1765	40,000	"
173	9° BT	.475	HiVel 2	30.0	1870		"
"	"	"	"	40.0	2450	37,000	"
"	"	"	"	45.8	2760	51,000	"
"	"	"	HiVel 3	28.0	1905		"
"	"	"	"	36.0	2375	34,500	"
"	"	"	"	43.4	2760	51,000	"
"	"	"	Lightn'g	24.0	1720		"
"	"	"	"	32.0	2200	32,300	"
"	"	"	"	39.8	2620	51 000	"
"	"	"	Sharpshooter	20.0	1765	23 000	"
"	"	"	"	28.4	2295	40 000	"
"	"	"	2400	20.0	1660	24 000	"
"	"	"	"	27.3	2120	40 000	"
"	"	"	Unique	14.0	1430	21 000	"
"	"	"	"	18.7	1800	40,000	"
180	"	.472	HiVel 2	30.0	1825		"
"	"	"	"	40.0	2400	34,800	"
"	"	"	"	46.2	2755	51 000	"
"	"	"	HiVel 3	28.0	1935		"
"	"	"	"	36.0	2395	35 000	"
"	"	"	"	42.6	2740	51,000	"
"	"	"	Lightn'g	24.0	1780		"
"	"	"	"	32.0	2260	32 500	"
"	"	"	"	39.0	2625	51,000	"
"	"	"	2400	18.0	1620	18,900	"
"	"	"	"	26.3	2130	40,000	"
"	"	"	Unique	13.0	1430	20,700	"
"	"	"	"	18.4	1840	40,000	"
190	.303 Sav.	.505	HiVel 2	30.0	1820		"
"	"	"	"	40.0	2345	30,500	"
"	"	"	"	45.8	2645	51,000	"
"	"	"	HiVel 3	26.0	1760		"
"	"	"	"	36.0	2310	35,400	"
"	"	"	"	42.2	2605	51,000	"
"	"	"	Lightn'g	25.0	1770		"
"	"	"	"	31.0	2110	33,200	"
"	"	"	"	38.0	2460	51,000	"
"	"	"	Sharpshooter	20.0	1720	21,000	
"	"	"	"	28.2	2180	40,000	"
"	"	"	2400	18.0	1480	20,000	"
"	"	"	"	26.6	1990	40,000	"
"	"	"	Unique	13.0	1340	21,100	"
"	"	"	"	18.2	1705	40,000	"
200	MC	.400	HiVel 2	24.0	1400		"
"	"	"	"	36.0	2075	30,000	"
"	"	"	"	45.0	2520	51,000	"
"	"	"	HiVel 3	25.0	1610		"
"	"	"	"	35.0	2150	34,200	"
"	"	"	"	41.4	2475	51,000	"
"	"	"	2400	18.0	1430	20 000	"
"	"	"	"	26.2	1895	40,000	"
207	GC	.464	HiVel 2	25.0	1580		"
"	"	"	"	34.0	2060	30 000	"
"	"	"	"	42.6	2420	51,000	"
"	"	"	HiVel 3	25.0	1740		"
"	"	"	"	35.0	2220	39,000	"
"	"	"	"	39.4	2400	51,000	"
"	"	"	Lightn'g	25.0	1745		"
"	"	"	"	33.0	2165	40,000	"
"	"	"	"	37.0	2340	51,000	"
"	"	"	Sharpshooter	17.0	1570	19 000	"
"	"	"	"	26.4	2060	40 000	"
"	"	"	2400	18.0	1570	19 700	"
"	"	"	"	25.1	1920	40,000	"
"	"	"	Unique	12.0	1355	19,200	"
"	"	"	"	17.2	1660	40,000	"
220	MC	.475	HiVel 2	28.0	1575		"
"	"	"	"	38.0	2140	36,000	"
"	"	"	"	43.6	2430	51,000	"
"	"	"	HiVel 3	25.0	1560		"
"	"	"	"	35.0	2100	37,500	"
"	"	"	"	40.4	2380	51,000	"
"	"	"	Lightn'g	20.0	1300		"
"	"	"	"	30.0	1900	32,500	"
"	"	"	"	38.2	2315	51,000	"
"	"	"	Sharpshooter	20.0	1520	20,300	"
"	"	"	"	27.2	1940	40,000	"
"	"	"	2400	18.0	1320	20,100	"
"	"	"	"	25.8	1800	40,000	"
"	"	"	Unique	12.0	1090	20,100	"
"	"	"	"	17.9	1495	40,000	"
225	Belted MC	.546	HiVel 2	24.0	1440		"
"	"	"	"	34.0	1945	32,000	"

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
225	Belted MC	.546	HiVel 2	42.2	2370	51,000	Her.
"	"	"	HiVel 3	22.0	1425		"
"	"	"	"	32.0	1950	34,700	"
"	"	"	"	38.8	2305	51,000	"
"	"	"	Lightn'g	18.0	1200		"
"	"	"	"	28.0	1805	30,500	"
"	"	"	"	36.2	2260	51,000	"
"	"	"	2400	18.0	1320	22,000	"
"	"	"	"	24.8	1750	40,000	"

.30 NEWTON

The .30 Newton was another of the developments of Charles Newton. It was somewhat similar to the .30 Springfield, but the cartridge case had a much larger capacity. The Western Cartridge Company, of East Alton, Illinois, manufactures loaded ammunition for this and can supply cases. Any .30-caliber bullet suitable for the Springfield can be used in this caliber. It is an extremely difficult cartridge to load, due to the large capacity of the cartridge case, and best powders for use in this are Du Pont #15½, #17½, and #3031, together with the new #4064. Of the group, #15½ would probably be best. The .30 Newton cartridge was produced around 1918. The original loading by Newton with 150-grain bullet was at a muzzle velocity of 3208 f.s. The 172-grain boattail bullet was driven at 3000 and the 225-grain bullet was driven at 2610. An ideal bullet for this heavy weight is the Western Tool & Copper Works line of magnum numbers designed chiefly for this cartridge and for the other super-high-power arms. Because of the tremendous powder capacity of this cartridge case, it does not lend itself well to extremely light or mid-range loads.

.30 Newton

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
110	MC	.200	15½	68.2	3500		Du P.
120	"	.250	"	66.7	3400		"
150	"	"	"	71.7	3150		"
"	"	"	15	71.0	3150		"
172	"	.300	15½	60.6	2640		"
"	"	"	"	68.2	2900		"
"	"	"	15	67.5	2850		"
"	"	"	HiVel 2	63.5	3070	54,500	Her.
180	"	.375	15½	69.5	3000		Du P.
"	"	"	H.Vel 2	63.0	3035	55,000	Her.
"	BT MC	"	15½	60.6	2400		Du P.
"	"	"	"	65.7	2860		"
220	MC	.525	"	57.5	2360		"
"	"	"	"	62.5	2510		"
"	"	"	15	62.0	2500		"

.300 H. & H. MAGNUM

The .300 Holland & Holland Magnum is essentially a British cartridge only recently popularized in the United States. It is a large-capacity cartridge of the "belted" type; in other words, it has a rim or belt around the body of the case at the head. The idea of this particular type of construction is definitely to control headspace or the depth at which the cartridge seats in the chamber of the gun. For several years the Western Cartridge Company has been manufacturing this cartridge together with others of the H. & H. series and in 1936 the Winchester people announced it as among their standard lines. The recommen-

.300 H. & H. Magnum

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 26-in. Barrel	Breech Pressure	Recommended by
110	MC	.225	15½	59.0	2860		Du P.
"	"	"	"	67.0	3125		"
120	WTCW	"	"	68.0			Keith
"	"	"	HiVel 2	54.0	3013[1]	38,800	GS
"	"	"	"	56.0	3142[1]	40,800	"
"	"	"	"	58.0	3261[1]	44,350	"
"	"	"	"	60.0	3329[1]	45,500	"
"	"	"	"	62.0	3419[1]	48,000	"
"	"	"	"	64.0	3530[1]	51,000	"
150	MC	.300	Cordite MDT	54.0	3094	45,000	R[2]
"	"	"	15½	57.0	2775		Du P.
"	"	"	"	63.0	3000		"
"	"	"	"	66.0	3050	46,850	GS
"	"	"	"	68.0	3150	50,400	"
"	"	"	"	69.0	3185	55,600	"
170	"	3.59[3]	"	60.0	2700	Low	R[4]
"	"	"	"	64.0	2975	Enough	"
"	"	"	"	66.0	3023	Max.	"
"	FA6° BT	"	"	"	3025	53,750[5]	JVH
172	WTCW	"	HiVel 2	61.0	3100	Max.	JBS
"	"	"	15½	65.0	3000	Max.	"
173	9° BT	.475	"	51.0	2550		Du P.
"	"	"	"	60.0	2800		"
"	"	"	"	61.0			Keith
"	"	"	"	66.0	3025	55,700	GS
"	"	"	16	57.0			Keith
"	"	3.60[3]	4064	45.0	2515		Du P.
"	"	"	"	55.3			TCF
"	"	"	"	58.5	3030		Du P.
180	MC BT	.325	15½	50.0	2400		"
"	"	"	"	58.0	2700	44,400	GS
"	"	"	"	60.0	2775		Du P.
"	"	"	"	62.0	2800	49,550	GS
"	"	"	"	64.0	2847	56,300	"
"	"	"	HiVel 2	56.0	2850	55,700	"
"	"	"	"	56.5	2854	Max.	Ideal 31
"	"	"	17½	47.0	2450	Low	JRM
"	"	"	Cordite MDT	50.0	2790	44,000	R[2]
"	"	.60	4064	45.0	2485		Du P.
"	"	"	"	57.5	3000		"
"	MC Flat	.375	80	16.0	1315		"
"	"	"	"	26.0	1850		"
"	"	"	HiVel 2	56.5	2865	55,700[5]	JVH
200	WTCW	"	"	58.6	2650	54,000	JBS
"	"	"	15½	61.0	2600	54,000	"
"	"	"	"	59.0	2500	Model	R[4]
220	MC	.425	"	45.0	2050		Du P.
"	"	"	"	56.0	2250		"
"	"	"	"	60.0	2525	53,200	GS
"	"	.375	80	20.0	1380		Du P.
"	"	"	"	28.0	1730		"
"	"	"	HiVel 2	50.0	2405	43,800	GS
"	"	"	"	55.0	2590	54,200	"
"	"	"	"	56.0	2625	56,450	"
"	"	"	Cordite MDT	45.0	2350	44,000	R[7]
"	Western BT	3.60[6]	4064	41.0	2080		Du P.
"	"	"	"	55.0	2580		"
225	WTCW	3.56[6]	HiVel 2	55.0	2575	54,000	JBS
"	"	"	15½	61.0	2500	"	"

[1] Instrumental velocity at 53 feet.
[2] *American Rifleman*, Sept. 1, 1925.
[3] Overall length.
[4] *American Rifleman*, Dec. 15, 1926.
[5] James V. Howe FA tests.
[6] Maximum length in Winchester Model 70 chamber.
[7] *American Rifleman*, Aug. 15, 1925.

dation of handloads in this caliber, however, is a rather delicate affair, since a great many of the thousands of guns to handle this cartridge are of the custom-built variety and each manufacturer has altered the chamber dimensions slightly to satisfy his own particular requirements. For this reason, Du Pont has refused to recommend handloads in this caliber, as a difference of a few thousandths of an inch in neck or shoulder diameter or taper can greatly affect pressure. In handloading for this, be sure that you follow the recommendations of the maker of your rifle. If in doubt, do not endeavor to load maximum loads.

The .300 H. & H. Magnum cartridge skyrocketed to fame when a custom-built job by Griffin & Howe on a Model 1917 action won the Wimbledon Match at Camp Perry in 1935. Ben Comfort, the winner, used standard Western factory loads with 180-grain full-metal-jacket boat-tail bullets.

Winchester has announced the new Model 70 rifle to handle this cartridge and the more powerful .375. This will mean standardization of chambers, and it is expected that both Du Pont and Hercules will come forward with loading data. The .300 H. & H. requires a longer action than standard, and about the only American repeating bolt action that can successfully handle it at the present time is the Model 1917. This action does, however, require certain alterations which several custom gunsmiths are equipped to do.

Some of the following .300 H. & H. loads, except those recommended as maximums, can be used in a similar cartridge, the .300 Dubiel.

The maximum overall length of this cartridge when loaded with the 173- or 180-grain boat-tail bullets is 3.60 inches. This seats the bullet into the throat of the rifling.

The .300 H. & H. Magnum cartridge will stand a great deal of experimental work. Its development has been greatly retarded by lack of standardized chambers, and present results are not up to its fine possibilities.

.303 SAVAGE

This particular cartridge, for which only Savage rifles have been chambered, is very similar to the .30/30 Winchester in its characteristics. It does, however, require a slightly larger bullet diameter, so that the average .30-caliber bullet is unsuited to this particular cartridge. It lends itself readily to handloading, both with cast bullets and with the jacketed variety. Working pressure is around 40,000 pounds. Do not exceed this pressure limit.

.303 Savage

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt Chg. Grs.	M V in 26-in. Barrel	Breech Pressure	Recommended by
80	.32/20	.233	2400	13.0	1700		Her.
"	"	"	"	17.0	2130	15 000	"
"	"	"	"	20.0	2440	22 000	"
"	"	"	"	24.4	2840	33.000	"
"	"	"	"	27 2	3065	41,000	"
"	"	"	HiVel 2	21.0	1710		"
"	"	"	"	31.0	2445	19,600	"
"	"	"	"	38.6	3170	41,000	"
"	"	"	Unique	11.0	2120	18,800	"
"	"	"	"	15.2	2590	33,000	"
"	"	.200	3031	38.0	2500		Du P.
"	"	.225	17½	35.0	2225		"
"	"	"	"	40.0	2600		"
"	"	"	SR 80	14.0	1925		"
"	"	"	"	20.0	2475		"
"	"	.233	Sharpshooter	18 0	2160	16,300	Her.
"	"	"	"	25 4	2830	33,000	"
"	"	"	Lightn'g	18 0	1740		"
"	"	"	"	27.0	2480	20,300	"
"	"	"	"	34 1	3100	41,000	"
85	7.63 mm. Mauser	.175	3031	39.0	2540		Du P.
"	"	150	17½	35.0	2175		"
"	"	"	"	40.0	2575		"
"	"	"	SR 80	14.0	1850		"
"	"	"	"	19.0	2275		"
93	7.65 mm. Luger	.275	3031	37 5	2425		"
"	"	250	17½	34.0	2100		"
"	"	"	"	39.0	2500		"
"	"	"	SR 80	12.0	1600		"
"	"	"	"	18.0	2125		"
100	.32/20	.275	3031	37 5	2450		"
"	"	.225	17½	33 0	2000		"
"	"	"	"	39 0	2485		"
"	"	"	SR 80	11.0	1450		"
"	"	"	"	17 0	1980		"
"	Lead	175	"	7.8	1130		"
"	"	"	"	15.0	1700		"
"	"	"	GR 75	6.0	1160		"
"	"	"	"	8.0	1350		"
"	"	"	"	10.0	1480		"
"	"	"	"	15.0	1785		"
110	.30/06 HP	.163	2400	9.0	1260		Her.
"	"	"	"	13.0	1595	14,600	"
"	"	"	"	17.0	1940	22,000	"
"	"	"	"	21.0	2275	33,000	"
"	"	"	"	22.5	2400	41,000	"
"	"	"	HiVel 2	16.0	1280		"
"	"	"	"	26.0	1990	21,100	"
"	"	"	"	34.2	2580	41,000	"
"	"	"	HiVel 3	12.0	1260		"
"	"	"	"	22.0	2060	20.300	"
"	"	"	"	30.2	2720	41,000	"
"	"	"	Lightn'g	18.0	1640		"
"	"	"	"	25.0	2175	24,300	"
"	"	"	"	30.9	2620	41.000	"
115	.32/20	.350	3031	36.0	2330		Du P.
"	"	.325	17½	33.0	1985		"
"	"	"	"	38.0	2400		"
"	"	"	SR 80	12.0	1450		"
"	"	"	"	16.0	1800		"
125	Lead	.300	"	13.0	1500		"
"	"	"	GR 75	10.0	1475		"
"	"	"	Unique	5 0	1314		Her.
"	"	"	"	6.5			"
150	MC	.169	HiVel 2	18.0	1410		"
"	"	"	"	26.0	1960	25.000	"
"	"	"	"	32.0	2360	41,000	"
"	"	"	HiVel 3	14.0	1330		"
"	"	"	"	22.0	1925	24,600	"
"	"	"	"	28 9	2440	41,000	"
"	"	.425	SR 80	11.0	1200		Du P
"	"	"	"	15.0	1675		"
"	"	.169	Her 300	37.0	24.0	35,000	Her
154	Lead	.425	SR 80	12.2	1375		Du P.
"	"	"	GR 75	10.0	1370		"
"	"	"	"	11.0	1460		"
169	GC "Squibb"	.525	2400	10.0	1160		Her
"	"	"	"	13.0	1415	15,500	"
"	"	"	"	15.0	1575	19,500	"
"	"	"	"	19.3	1910	33,000	"
"	"	"	"	20.8	2025	41,000	"
"	"	"	HiVel 2	16.0	1220		"
"	"	"	"	24.0	1760	20,200	"
"	"	"	"	31.8	2280	41,000	"
"	"	"	HiVel 3	12.0	1100		"
"	"	"	"	19.0	1685	16,600	"
"	"	"	"	27.4	2300	41,000	"
"	"	"	Lightn'g	22.0	1900	23,000	"

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 26-in. Barrel	Breech Pressure	Recommended by
169	GC "Squibb"	.525	Unique	9.0	1390	18,500	Her.
"	"	"	"	11.7	1635	33,000	"
"	"	"	Lightn'g	12.0	1120		"
"	"	"	"	27.0	2240	41,000	"
"	"	"	Sharpshooter	14.0	1630	16,000	"
"	"	"	"	19.2	2035	33,000	"
180	MC	"	18	25.0	1610[1]		Du P.
"	"	"	"	30.0	1825[1]		"
185	"	.550	Lightn'g	25.0	1960[1]		Her.
"	"	"	Unique	8.0	1080		"
190	"	.557	2400	10.0	910		"
"	"	"	"	13.0	1195	15,400	"
"	"	"	"	16.0	1480	25,000	"
"	"	"	"	17.9	1660	33,000	"
"	"	"	"	19.5	1820	41,000	"
"	"	"	HiVel 2	16.0	1070		"
"	"	"	"	25.0	1720	24,200	"
"	"	"	"	30.1	2080	41,000	"
"	"	"	HiVel 3	12.0	950		"
"	"	"	"	21.0	1650	23,800	"
"	"	"	"	27.4	2150	41,000	"
"	"	"	Her. 300	33.4	2070[1]	38,000	"
"	"	"	Her. 308	30.3	1940[1]		"
"	"	"	Unique	8.0	1012	18,700	"
"	"	"	"	11.3	1390	33,000	"
"	"	.525	3031	30.0	1840		Du P.
"	"	"	"	33.5	2090		"
"	"	"	17½	26.0	1630		"
"	"	"	"	32.6	1982		"
"	"	"	16	25.0	1630		"
"	"	"	"	31.3	1980		"
"	"	"	SR 80	10.0	765		"
"	"	"	"	14.0	1250		"
"	"	.557	Sharpshooter	13.0	1335	17,600	Her.
"	"	"	"	17.6	1695	33,000	"
"	"	"	Lightn'g	12.0	900		"
"	"	"	"	20.0	1530	21,700	"
"	"	"	"	25.8	1990	41,000	"
"	"	.525	4198	20.0	1498		Du P.
"	"	"	"	27.5	2000		"
"	"	"	4320	32.0	1850		"
"	"	"	"	36.5	2145		"
196	Lead	.593	HiVel 2	24.0	1805	26,200	Her.
"	"	"	Unique	10.2	1395	30,000	"
"	"	"	Sharpshooter	15.0	1540	25,800	"

[1] Velocity with corrosive primer.

.303 BRITISH

This cartridge is the standard of Great Britain and Canada and is commercially loaded with a single weight of bullet, 215-grain. The cartridge case is very similar to that of the Krag. The bullet is also similar to the old Krag type, but a few grains lighter. Most of the 8 mm. bullets can be used in this caliber, but owing to the wide variations in the diameters of bores in this particular caliber it is wise to first slug the bore.

The .303 British, as originally used by the British Government, was known as the .303 Mark II. It used a 215 grain bullet. For more than a quarter-century, however, the British cartridge has been known as the Mark VII and uses a 174-grain pointed bullet. This Mark VII bullet is somewhat different from the ordinary run in that it has a compound core. The forward portion or tip inside of the jacket is made of aluminum, while the remainder is of the conventional lead alloy. The object of this is to place the weight farther back in the bullet and thus to make the bullet longer for its weight than would otherwise be possible. The British also admit in the 1929 Small Arms Manual that one of the reasons for this unequal distribution of weight is that the bullet thus manufactured is more unstable than a bullet with a conventional core and upon impact is inclined to turn over or "keyhole." This gives much more serious wounding power than would

.303 British

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
80	.32/20	.232	2400	15.0	1680		Her.
"	"	"	"	18.0	2040	13,500	"
"	"	"	"	21.0	2350	20,800	"
"	"	"	"	23.5	2560	28,000	"
"	"	"	"	25.6	2735	35,000	"
"	"	"	HiVel 2	25.0	1845		"
"	"	"	"	36.0	2500	20,000	"
"	"	"	"	43.8	3040	35,000	"
"	"	"	HiVel 3	22.0	1800		"
"	"	"	"	34.0	2720	22,700	"
"	"	"	"	40.2	3180	35,000	"
"	"	"	Unique	12.0	2000	16,200	"
"	"	"	"	16.4	2460	28,000	"
"	"	.200	3031	40.0	2345		Du P.
"	"	"	"	45.5	2700		"
"	"	"	17½	37.5	2110		"
"	"	"	"	46.0	2775		"
"	"	.232	Sharpshooter	21.0	2375	17,500	Her.
"	"	"	"	25.8	2770	28,000	"
"	"	"	Lightn'g	22.0	1850		"
"	"	"	"	29.0	2340	20,100	"
"	"	"	"	37.8	2985	35,000	"
115	.32/20 MC	.354	2400	13.0	1530		"
"	"	"	"	15.0	1670	14,500	"
"	"	"	"	17.0	1820	19,600	"
"	"	"	"	20.2	2030	28,000	"
"	"	"	"	22.7	2220	35,000	"
"	"	"	HiVel 2	20.0	1280		"
"	"	"	"	28.0	1900	17,100	"
"	"	"	"	36.7	2550	35,000	"
"	"	"	HiVel 3	18.0	1550		"
"	"	"	"	23.0	1950	16,700	"
"	"	"	"	31.7	2620	35,000	"
"	"	.350	3031	38.0	2220		Du P.
"	"	"	"	43.0	2545		"
"	"	"	17½	[illegible]4.8	1900		"
"	"	"	"	[illegible].5	2575		"
"	"	.354	Lightn'g	13.0	1170		Her.
"	"	"	"	23.0	1870	18 200	"
"	"	"	"	32.8	2550	35,000	"
"	"	"	Sharpshooter	17.0	1785	16,500	"
"	"	"	"	22.4	2250	28,000	"
125	Lead	.267	Unique	10.0	1500		"
150	.30/06 MC	.247	2400	10.0	880		"
"	"	"	"	16.0	1460	15,200	"
"	"	"	"	17.0	1550	17,300	"
"	"	"	"	21.2	1880	28,000	"
"	"	"	"	23.2	2040	35,000	"
"	"	"	HiVel 2	16.0	1040		"
"	"	"	"	26.0	1700	17 100	"
"	"	"	"	36.3	2380	35,000	"
"	"	"	HiVel 3	18.0	1430		"
"	"	"	"	23.0	1780	17,200	"
"	"	"	"	31.6	2380	35,000	"
"	"	"	17½	42.0	2345		Du P.
"	"	"	"	46.0	2550		"
"	"	"	16	40.0	2410		"
"	"	"	Sharpshooter	16.0	1570	15,800	Her.
"	"	"	"	22.6	2075	28,000	"
155	Lead	.418	Unique	10.0	1350	16,100	"
174	MC	.439	2400	13.0	1060		"
"	"	"	"	15.0	1260	14,500	"
"	"	"	"	17.0	1440	19,500	"
"	"	"	"	19.5	1645	28,000	"
"	"	"	"	21.3	1790	35,000	"
"	"	"	HiVel 2	14.0	800		"
"	"	"	"	22.0	1360	16,700	"
"	"	"	"	32.7	2110	35,000	"
"	"	"	HiVel 3	15.0	1100		"
"	"	"	"	19.0	1400	17,000	"

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
174	MC	.439	HiVel 3	28.4	2090	35,000	Her.
"	"	.425	3031	37.0	2110		Du P.
"	"	"	"	42.0	2410		"
"	"	"	17½	41.0	2220		"
"	"	"	"	45.0	2450		"
"	"	"	18	41.0	2360[1]		"
"	"	"	Pyro	36.0	2110[1]		"
"	"	"	Her.300	41.8	2360[1]	44,000	Her.
"	"	"	Her.308	38.5	2180[1]		"
"	"	"	WA	40.5			"
"	"	"	16	40.0	2400[1]		Du P.
"	"	"	"	43.0	2500[1]	45,000	"
"	"	"	"	46.5	2750[1]	51,000	"
"	"	"	SR 80	15.0	1240		"
"	"	"	"	20.0	1500		"
"	"	"	GR 75	10.0	950		"
"	"	"	Lightn'g	34.5	2360[1]	51,000	Her.
"	"	"	4064	38.0	2000		Du P.
"	"	"	"	43.0	2300		"
"	"	"	4320	39.0	2055		"
"	"	"	"	45.0	2415		"
210	GC	.345	2400	8.0	900		Her.
"	"	"	"	13.0	1210	14,600	"
"	"	"	"	15.0	1340	19,000	"
"	"	"	"	18.6	1565	28,000	"
"	"	"	"	20.7	1700	35,000	"
"	"	"	HiVel 2	11.0	940		"
"	"	"	"	22.0	1410	16,800	"
"	"	"	"	32.0	1990	35,000	"
"	"	"	HiVel 3	12.0	1030		"
"	"	"	"	20.0	1500	17,600	"
"	"	"	"	28.2	1980	35,000	"
"	"	"	Unique	9.0	1100	14,800	"
"	"	"	"	13.0	1420	28,000	"
"	"	"	Lightn'g	21.0	1500[2]		"
"	"	"	"	12.0	960		"
"	"	"	"	18.0	1300	16,100	"
"	"	"	"	27.6	1910	35,000	"
"	"	"	Sharpshooter	13.0	1300	15,000	"
"	"	"	"	19.4	1675	28,000	"
215	MC	.357	2400	12.0	940		"
"	"	"	"	13.0	1000	15,500	"
"	"	"	"	14.5	1150	18,400	"
"	"	"	"	18.5	1400	28,000	"
"	"	"	"	20.3	1530	35,000	"
"	"	"	HiVel 2	12.0	700		"
"	"	"	"	20.0	1200	16,700	"
"	"	"	"	30.8	1870	35,000	"
"	"	"	HiVel 3	11.0	810		"
"	"	"	"	17.0	1180	17,500	"
"	"	"	"	27.3	1820	35,000	"
"	"	.375	17½	37.4	1920		Du P.
"	"	"	"	41.6	2150		"
"	"	"	3031	36.0	1990		"
"	"	"	"	40.0	2175		"
"	"	"	SR 80	14.0	1095		"
"	"	"	"	15.0	1270		"
"	"	.350	"	19.5	1370		"
"	"	"	16	36.0	1920[1]		"
"	"	"	"	39.5	2070[1]	45,000	"
"	"	"	18	36.5	1970[1]		"
"	"	"	"	38.0	2070[1]		"
"	"	"	Her.300	37.7	1920[1]	38,000	Her.
"	"	"	Her.308	37.1	1950[1]	40,000	"
"	"	"	WA	37.5			"
"	"	.375	Lightn'g	14.0	900		"
"	"	"	"	19.0	1230	18,800	"
"	"	"	"	27.7	1780	35,000	"
"	"	"	Sharpshooter	12.0	1020	15,200	"
"	"	"	"	19.0	1460	28,000	"
"	"	"	4064	38.5	1970		Du P.
"	"	"	"	42.5	2180		"
"	"	"	4320	38.0	1955		"
"	"	"	"	43.5	2245		"

[1] Velocity with corrosive primer.
[2] Estimated velocity.

be possible if the bullet kept point on. The cartridge is unusually excellent in handloading, though one is handicapped in the selection of bullets. Working pressures of this gun for bolt-action arms are in the vicinity of 45,000 pounds. Do not attempt to reload for the Ross rifle, as all of these chambers are so considerably oversize that one cannot properly handle the fired cases in conventional loading tools. It is entirely practical, however, to reload for the Enfield and other British firearms; also American-made arms designed to handle this particular caliber.

.303 ELLIOTT EXPRESS

The .303 Elliott Express cartridge was designed for single-shot and double rifles built by O. H. Elliott & Co., at South Haven, Michigan. It is one of the series of three calibers, details on which may be found under the .277 Elliott Express on another page.

The .303 Elliott Express uses the .303 British bullet and all others having a diameter of .311 inch. Many of the 7.62 mm. Russian bullets may also be used as well as certain oversized .30-caliber bullets. Bore diameter is .303 inch; groove diameter runs .311 inch; barrel is rifled with eight grooves and has a ten-inch twist.

.303 Elliott Express

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 28-in. Barrel	Breech Pressure	Recommended by
172	.303 British WT&C	.250	4320	44.0	2500		OHB
"	"	"	"	52.0	2850		"
"	"	"	4064	43.0	2475		"
"	"	"	"	50.0	2840		"
215	Western .303 Brit. SPBT	.430	4320	41.0	2175		"
"	"	"	"	48.0	2460		"

7.62 MM. RUSSIAN

This cartridge is essentially a military number, designed for the Russian Army Rifle and in use for a great many years. Originally it used a round-nosed bullet, the round-nosed type weighing 214 grains. This was changed at about the time of the World War, however, to a pointed bullet very similar to the old .30/06 but weighing 148 grains as made in Europe or 145 grains as made in this country. Essentially it was the same bullet as the .30/06 150-grain, the lighter weight being achieved through a conical cavity in the base of the bullet. Since the bullet was somewhat undersized, the idea of this conical cavity was to create proper upset during firing, so that the bullet would fill the rifling. Many thousands of these Russian rifles were manufactured in this country by several firms, notably the New England Westinghouse Company, Winchester, and Remington.

When the Revolution broke out in Russia, the United States Government took over these rifles

rather than permit them to be shipped overseas, and many were used for training purposes during the World War. Following the war, they were sold to NRA members, both in used and in new condition. Thousands upon thousands of cases of ammunition were also sold to members at the excessively low price of about $5 per case of one thousand rounds. Many shooters altered the rifles to sporters, and the demand for the ammunition therefore continued after the military issue became exhausted, so that Remington still manufactures the ammunition as a sporting cartridge. The majority of .30-caliber bullets can be used in this particular caliber, although barrels are somewhat over-

7.62 Russian

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
102	Lead	.225	SR 80	8.0	1000		Du P.
"	"	"	"	12.0	1380		"
110	MC .30/06	.200	3031	46.0	2715		"
"	"	"	"	51.0	3015		"
"	"	"	17½	46.0	2500		"
"	"	"	"	53.0	2950		"
"	"	"	Her.300	52.0	3090[1]		Her.
"	"	"	4320	48.0	2700		Du P.
"	"	"	"	56.0	3100		"
"	"	"	4064	52.0	2810		"
115	.32/20	.300	SR 80	16.0	1340		"
"	Lead	.350	"	14.0	1340		"
150	MC .30/06	.216	HiVel 2	28.0	1650		Her.
"	"	"	"	36.0	2100	22,300	"
"	"	"	"	43.6	2520	36,000	"
"	"	"	HiVel 3	18.0	1205		"
"	"	"	"	29.0	2035	19,800	"
"	"	"	"	36.4	2475	36,000	"
"	"	"	Lightn'g	40.0	2655[1]	45,000	"
"	"	"	Her.300	50.0	2690[1]	43,000	"
"	"	"	Unique	12.0	1400	16,000	"
"	"	"	"	16.0	1740	29,000	"
"	"	.225	3031	45.0	2550		Du P.
"	"	"	"	50.0	2830		"
"	"	"	17½	51.6	2680		"
"	"	"	15½	53.5	2700		"
"	"	"	"	54.0	2740		JBS
"	"	"	1147	49.0	2485		Du P.
"	"	"	"	54.5	2825		"
"	"	"	"	55.0	2875		JBS
"	"	"	18	36.0	1740[1]		Du P.
"	"	"	"	40.0	2000[1]		"
"	"	"	"	44.0	2280[1]		"
"	"	"	"	51.0	2700[1]		"
"	"	"	16	48.0	2600[1]		"
"	MC	"	SR 80	15.0	1090		"
"	"	"	"	22.0	1730		"
"	"	.216	Lightn'g	18.0	1215		Her.
"	"	"	"	28.0	1910	19,500	"
"	"	"	"	37.0	2400	36,000	"
"	"	"	Sharp-shooter	20.0	1770	17,000	"
"	"	"	"	26.4	2190	29,000	"
"	"	"	2400	19.0	1685	15,200	"
"	"	"	"	25.6	2150	29,000	"
"	"	.25	4320	47.0	2515		Du P.
"	"	"	"	53.0	2875		"
"	"	"	4064	47.0	2525		"
"	"	"	"	51.0	2760		"
"	Lead	.345	Unique	11.0	1300	16,400	Her.
169	GC "Squibb"	.365	HiVel 2	25.0	1480		"
"	"	"	"	31.0	1800	19,500	"
"	"	"	"	40.0	2250	31,000	"
"	"	"	HiVel 3	20.0	1460		"
"	"	"	"	28.0	1940	22,000	"
"	"	"	"	35.0	2260	34,000	"
"	"	"	Unique	11.0	1270	16,400	"
"	"	"	"	15.4	1570	29,000	"
"	"	.300	17½	29.0	1645		Du P.
"	"	"	"	37.0	2025		"
"	"	.365	Sharp-shooter	18.0	1610	16,800	Her.
"	"	"	"	25.0	2020	29,000	"
"	"	"	Lightn'g	15.0	1105		"
"	"	"	"	27.0	1770	21,000	"
"	"	"	"	36.0	2130	36,000	"
"	"	"	2400	18.0	1600	14,400	"
"	"	"	"	24.9	1980	29,000	"
170	MC .30/30	.475	3031	40.0	2200		Du P.
"	"	"	"	45.0	2470		"
170	MC .30/30	.225	17½	45.0	2240		Du P.
"	"	"	15½	53.5	2520		"
"	"	"	18	38.0	1920[1]		"
"	"	"	"	42.0	2140[1]		"
"	"	"	"	46.0	2330[1]		"
"	"	"	"	49.0	2450[1]		"
"	"	"	16	44.0	2100[1]		"
"	"	"	SR 80	14.0	1050		"
"	"	"	"	23.0	1710		"
173	9° BT	.475	3031	40.0	2290		"
"	"	"	"	45.5	2565		"
"	"	.450	1147	48.0	2420		"
"	"	"	"	50.0	2535		"
"	"	.475	4064	42.0	2265		"
"	"	"	"	48.0	2505		"
"	"	"	4320	41.0	2210		"
"	"	"	"	48.5	2610		"
180	MC .30/06	.300	3031	40.5	2190		"
"	"	"	"	45.0	2450		"
"	"	"	17½	46.0	2330		"
"	"	"	15½	52.5	2450		"
"	"	"	18	38.0	1910[1]		"
"	"	"	"	42.0	2200[1]		"
"	"	"	"	46.0	2340[1]		"
"	"	"	"	48.0	2440[1]		"
"	"	"	16	46.0	2370[1]		"
"	"	"	1147	48.0	2345		"
"	"	"	"	50.0	2460		"
"	"	"	SR 80	13.0	1000		"
"	"	"	"	23.0	1675		"
"	Lead	.340	Unique	10.0	1180	15,700	Her.
"	"	"	"	15.0	1450	29,000	"
184	Gebhardt lead	.300	SR 80	10.0	1000		Du P.
"	"	"	"	16.0	1400		"
"	"	"	Unique	10.0	1150		"
"	"	"	"	15.0	1400	29,000	"
190	MC .303 Sav.	.298	HiVel 2	24.0	1285		Her.
"	"	"	"	32.0	1745	21,500	"
"	"	"	"	41.6	2200	36,000	"
"	"	"	HiVel 3	20.0	1300		"
"	"	"	"	28.0	1790	21 700	"
"	"	"	"	35.2	2150	36,000	"
"	"	"	Unique	11.0	1130	17,000	"
"	"	"	"	15.3	1435	29,000	"
"	"	"	2400	17.0	1400	15,000	"
"	"	"	"	24.0	1820	29,000	"
195	"	.375	1147	50.0	2475	Max.	JBS
207	GC	"	HiVel 3	28.0	1900[1]		"
220	MC .30/06	.392	HiVel 2	20.0	1000		Her.
"	"	"	"	30.0	1590	22,000	"
"	"	"	"	39.8	2085	36,000	"
"	"	"	HiVel 3	18.0	1060		"
"	"	"	"	24.0	1480		"
"	"	"	"	33.0	1940		"
"	"	"	Unique	11.0	940	18,300	"
"	"	"	"	14.7	1200	29,000	"
"	"	.375	3031	36.0	1900		Du P.
"	"	"	"	41.5	2140		"
"	"	"	17½	44.0	2025		"
"	"	"	15½	50.5	2225		"
"	"	"	1147	44.0	1990		"
"	"	"	"	48.0	2230		"
"	"	"	18	37.0	1820[1]		"
"	"	"	"	41.0	2000[1]		"
"	"	"	"	44.0	2100[1]		"
"	"	"	16	43.0	2050[1]		"
"	"	"	SR 80	14.0	960		"
"	"	"	"	21.0	1380		"
"	"	.392	Sharp-shooter	18.0	1290	19,100	Her.
"	"	"	"	23.0	1610	29,000	"
"	"	"	2400	16.0	1150	15,000	"
"	"	"	"	23.0	1615	29,000	"
"	MC	"	Lightn'g	18.0	1010		"
"	"	"	"	25.0	1495	21,000	"
"	"	"	"	33.4	1930	36,000	"
"	"	.375	4320	37.0	1895		Du P.
"	"	"	"	44.0	2170		"
"	"	"	4064	39.0	1915		"
"	"	"	"	45.0	2200		"

[1] Velocity with corrosive primer.
[2] Estimated velocity.

size for them. The author has had excellent results with the FA Mark I bullet. Maximum loading pressure of this cartridge is in the vicinity of 45,000 pounds. Rifles should be in good condition, however, if this pressure is to be used continuously.

7.65 MM. MAUSER

This is another military cartridge which has found wide favor in the United States. It is frequently called the "Belgian Mauser," but a great many other nations use this particular cartridge as their military standard. The Winchester Model 54 and the Remington 30-S are chambered to handle it, and the commercial cartridge is loaded with suitable sporting bullets. Commercial bullets are made in 154, 215, 216, and 219-grain weights and have a diameter of .3115 to .312. It will, therefore, be seen that barrels chambered for this cartridge will not properly handle the regular .30-caliber numbers with reasonable success, owing to their small diameter of about .3085. There are, however, a great many different jacketed bullets obtainable in this country which can be used in this caliber. The table of bullet diameters in the Appendix will supply this information.

8 MM. MAUSER (7.9 MM.)

Of all the military cartridges on the market for which bullets and cases are readily available, this is one of the most difficult to load—because of the tremendous variation in barrels. Although generally thought of as the German Military Cartridge, this same cartridge is widely used by a great many other nations, both in Europe and in South America. This member of the Mauser family originally began life as the 7.9 mm. and used a 227-grain round-nosed bullet having a diameter of .3189. In the early 1900's a 154.5-grain bullet of

7.65 mm. Mauser

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
154	MC	.250	3031	36.0	2225		Du P.
"	"	"	"	38.0	2350		"
"	"	"	"	45.5	2760		"
"	"	"	17½	42.0	2350		"
"	"	"	"	50.0	2730		"
"	"	"	SR 80	18.0	1380		"
"	"	"	16	45.5	2550[1]		"
"	"	"	"	50.0	2650[1]		"
"	"	.210	Unique	11.0	1200		Her.
"	"	"	"	14.8	1620		"
"	"	.250	15	47.0	2640[1]		Du P.
"	"	"	21	42.0	2650[1]		"
"	"	.210	Her.300	46.0	2610[1]	41,000	Her.
"	"	"	Sharpshooter	19.0	1725	17,500	"
"	"	"	"	24.2	2090	27,000	"
"	"	"	Lightn'g	21.0	1500		"
"	"	"	"	28.0	2000	23,500	"
"	"	"	"	33.0	2[illegible]	33,000	"
"	"	"	2400	19.0	1640	16,800	"
"	"	"	"	22.9	1970	27,000	"
"	"	.250	4320	41.0	2275		Du P.
"	"	"	"	49.0	2800		"
"	"	"	4064	41.0	2275		"
"	"	"	"	46.5	2690		"
169	GC "Squibb"	.195	Unique	11.0	1370	17,000	Her.
"	"	"	"	14.8	1670	27,000	"
"	"	"	Sharpshooter	18.0	1735	16,600	"
"	"	"	"	24.0	2065	27,000	"
"	"	"	Lightn'g	21.0	1541		"
"	"	"	"	27.0	1920	21,000	"
"	"	"	"	31.0	2085	28,500	"
"	"	"	2400	17.0	1550	16,000	"
"	"	"	"	24.0	2020	26,000	"
208	GC	"	Lightn'g	21.0			"
215	MC	.210	Unique	10.0	1000	16,500	"
"	"	"	"	14.3	1300	27,000	"
"	"	"	Sharpshooter	16.0	1330	17,000	"
"	"	"	"	21.6	1700	27,000	"
"	"	"	Lightn'g	20.0	1300		"
"	"	"	"	26.0	1660	23,500	"
"	"	"	"	31.0	1940	33,000	"
"	"	"	2400	15.0	1180	15,000	"
"	"	"	"	21.6	1600	27,000	"
219	MC	.210	Her.300	44.5	2210	43,000	"
"	"	"	Lightn'g	30.4	1900	33,000	"

[1] Velocity with corrosive primer.

8 mm. (7.9) Mauser

Haenel Mannlicher, Mod. 1888
Mannlicher-Schoenauer, Mod. 1908
Remington 30-S, Winchester 54, and others

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
154	MC	.125	HiVel 2	25.0	1540		Her.
"	"	"	"	33.0	2000	21,200	"
"	"	"	"	42.2	2500	35,000	"
"	"	"	HiVel 3	20.0	1480		"
"	"	"	"	28.0	2060	20,500	"
"	"	"	"	34.4	2460	35,000	"
"	"	"	Unique	11.0	1400	16,600	"
"	"	"	"	15.6	1780	28,000	"
"	"	"	Her.300	48.0	2690[1]	45,000	"
"	"	.250	3031	45.0	2490		Du P.
"	"	"	"	51.0	2770		"
"	"	.200	17½	53.0	2800		"
"	"	"	1147	53.0	2575		"
"	"	"	"	57.0	2775		"
"	"	"	16	47.5	2600[1]		"
"	"	"	SR 80	18.5	1550		"
"	"	"	"	24.0	1900		"
"	"	"	18	48.0	2640		"
"	"	.125	Sharpshooter	19.0	1760	16,500	Her.
"	"	"	"	24.6	2130	28,000	"
"	"	"	Lightn'g	18.0	1520		"
"	"	"	"	26.0	1860	20,000	"
"	"	"	"	34.4	2375	35,000	"
"	"	"	2400	18.0	1630	15,500	"
"	"	"	"	23.6	2030	28,000	"
"	"	.25	4198	34.0	2285		Du P.
"	"	"	"	43.5	2730		"
"	"	"	4064	53.0	2745		"
"	"	"	4320	47.0	2485		"
"	"	"	"	56.5	2900		"
165	.32/40 MC	.300	17½	45.0	2450[2]		JBS
170	MC .32 Rem.	.425	3031	43.0	2385		Du P.
"	"	"	"	48.0	2600		"
"	"	.375	17½	45.0	2300		"
"	"	"	"	50.0	2570		"
"	"	.322	Unique	10.0	1215	15,200	Her.
"	"	"	"	14.6	1600	28,000	"
"	"	"	Her.300	45.2	2370	39,000	"
"	"	"	Sharpshooter	18.0	1650	17,600	"
"	"	"	"	23.2	2000	28,000	"
"	"	"	Lightn'g	17.0	1180		"
"	"	"	"	24.0	1680	19,500	"
"	"	"	"	33.0	2185	35,000	"
"	"	"	2400	17.0	1480	14,600	"
"	"	"	"	22.2	1860	28,000	"
175	WTCW	.250	15½	50.0	2500[2]		JBS
181	GC	.304	Lightn'g	20.0	1450		Her.
"	"	"	"	26.0	1800	18,500	"
"	"	"	"	33.8	2150	35,000	"

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seat-ing Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pres-sure	Recom-mended by
181	GC	.304	Sharp-shooter	18.0	1655	16,700	Her.
"	"	"	"	22.0	1900	28,000	"
"	"	"	2400	17.0	1560	16,000	"
"	"	"	"	22.4	1900	28,000	"
227	MC	.225	SR 80	14.0	1040		Du P.
"	"	"	"	22.0	1510		"
"	"	"	1147	43.0	1940		"
"	"	"	"	49.5	2200		"
"	"	"	15½	50.0	2240		"
"	"	"	"	52.0	2335		"
"	"	"	16	46.5	2200[1]		"
"	"	"	Lightn'g	42.0	2000[1]		Her.
"	"	"	"	46.7	2300[1]		"
"	"	"	Her.300	42.0	2000[1]	35,000	"
"	"	"	"	46.0	2300[1]	51,000	"
"	"	.250	3031	39.0	1950		Du P.
"	"	"	"	46.5	2265		"
"	"	"	4198	33.0	1895		"
"	"	"	"	39.0	2025		"
"	"	"	4064	44.0	2065		"
"	"	"	"	50.0	2345		"
"	"	"	4320	39.0	1925		"
"	"	"	"	48.0	2280		"
236	"	.303	HiVel 2	18.0	940		Her.
"	"	"	"	28.0	1540	19,500	"
"	"	"	"	38.2	2050	35,000	"
"	"	"	HiVel 3	18.0	965		"
"	"	"	"	24.0	1400	20,300	"
"	"	"	"	32.2	1920	35,000	"
"	"	"	Unique	10.0	1000	17,000	"
"	"	"	"	14.0	1300	28,000	"
"	"	"	Her.300	43.8	2025[1]	42,000	"
"	"	.250	3031	34.0	1750		Du P.
"	"	"	"	45.5	2200		"
"	"	"	17½	46.0	"		"
"	"	"	16	46.0	2100[1]		"
"	"	"	18	44.7	2150[1]		"
"	"	"	15½	49.0	2190		"
"	"	"	15	47.0	2000[2]		"
"	"	"	1147	42.0	1910		"
"	"	"	"	47.5	2140		"
"	"	.303	Sharp-shooter	16.0	1280	16,500	Her.
"	"	"	"	21.8	1640	28,000	"
"	"	"	Lightn'g	15.0	995		"
"	"	"	"	23.0	1460	19,500	"
"	"	"	"	31.6	1920	35,000	"
"	"	"	2400	16.0	1220	15,500	"
"	"	"	"	21.2	1535	28,000	"
"	"	.250	4064	41.0	1950		Du P.
"	"	"	"	49.0	2275		"
"	"	"	4320	38.0	1760		"
"	"	"	"	46.5	2210		"
"	GC	.310	Unique	10.0	1205	17,300	Her.
"	"	"	"	13.2	1320	28,000	"
"	"	"	Sharp-shooter	14.5	1275	14,000	"
"	"	"	"	21.2	1670	28,000	"
"	"	"	Lightn'g	15.0	1080		"
"	"	"	"	22.0	1670	18,500	"
"	"	"	"	28.0	1770	29,000	"
"	"	"	2400	15.0	1225	14,300	"
"	"	"	"	21.1	1580	28,000	"

[1] Velocity with corrosive primer.
[2] Estimated velocity.

the pointed type was adopted, and the caliber was changed from 7.9 mm. to 8 mm. At the same time the bullet diameter was increased to .323 according to German specifications. In the old Model 1898 Mauser, with barrel chambered for the round-nose heavy bullet, the modern 154-grain pointed cannot be used, owing to the increased diameter; but the old-style can be used in the modern rifle with reasonable success. It is quite possible that many of the old-type barrels can be found in the United States. Therefore, make sure of your bullet diameter by driving a slug through the bore before attempting any reloading, as an oversized bullet can create extremely dangerous pressures.

Handloading for this particular caliber is very desirable, since there are so many barrel sizes on the American market that commercial ammunition in this caliber has been more or less of a compromise to shoot reasonably well in all barrels and excellently in none.

8 MM. AUSTRIAN MANNLICHER

Essentially this cartridge is the Austrian military cartridge. A great many of these rifles are available in this country, but the cartridge is not loaded commercially here and is therefore extremely difficult to locate. Imported cases can be obtained both with the Berdan primer and with the conventional anvil-contained type of primer. It is an extremely large-bodied cartridge and is not a good number for reloading. The majority of 8-mm. bullets will work satisfactorily in this caliber.

8 mm. Mannlicher Rimmed

Greek, Bulgarian and Austrian, Mod. 95

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seat-ing Depth	Kind	Wgt. Chg. Grs.	M V in 30-in. Barrel	Breech Pres-sure	Recom-mended by
154	MC	.250	SR 80	11.0	1000		Du P.
"	"	"	"	16.5	1500		"
"	"	"	17½	39.5	1900		"
"	"	"	"	52.0	2850		"
241	"	"	SR 80	14.0	1000		"
"	"	"	"	20.0	1400		"
"	"	"	17½	43.0	1900		"
"	"	"	"	50.0	2400		"

8 MM. LEBEL

This is the French military cartridge as used today. It was the first small-bore cartridge used by any nation as an official military cartridge. France brought out this particular cartridge in 1886 and has improved it very little since that time. The standard load uses a 198-grain solid copper boat-tail bullet, the only solid bullet in the military field. This was loaded extensively on contract in the United States during the World War, and many of the French rifles also were made in this country. They were so common at the close of the World War that Remington has continued to manufacture the cartridge as a sporting number even up to date. It is not a good one for reloading purposes, as the case body does not have the customary straight taper from head to neck. It is of the rimmed variety, and the body has the outward curve or "belly" at about the half-way point between head and shoulder. It can be reloaded, however, with proper patience, and suitable dies.

8 mm. Lebel

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 31½-in. Barrel	Breech Pressure	Recommended by
198	Copper	.575	17½	44.5	2300		Du P.
"		"	Her.300	"	2360		Her.

.318 NITRO EXPRESS

This is another of the W-R numbers that are very popular in England and are used by a number of American sportsmen as well. The cartridge case is not made in this country, therefore it is necessary to import cases. Only a few loads have been developed in this caliber, as the particular field is amply cared for with a number of others on the American market, chiefly the .300 H. & H. Magnum. Often called ".318 Accelerated Express."

.318 Nitro Express

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 26-in. Barrel	Breech Pressure	Recommended by
250	MC		17½	40.0	1770[1]		Du P.
"	"		"	48.4	2200[1]		"
"	"		15½	50.5	2275[1]		"

[1] Velocity with corrosive primer.

.32 WCF (.32/20)

This particular cartridge is adapted to both revolver and rifle use. When properly loaded, it is an excellent cartridge for both short-range targets up to 100 yards and small-game and varmint shooting. It is not suitable for game as large as deer. The handloader must bear in mind, however, that in loading this cartridge he must not try to achieve an all-round load suitable for either rifle or handgun. The short barrels in revolvers necessitate entirely different powder—one which will burn quickly so that its whole benefit will be achieved. Also the later-model rifles will stand a much higher pressure than the average revolver in this caliber. High-velocity loadings for handgun use are not at all practical and should be avoided. In recent years, this has been factory-loaded with high-velocity loading for rifle use with an 80-grain bullet and the standard-velocity cartridge with 115-grain soft-point type of bullet.

Nearly 40 years ago, when it was at the height of its popularity, it was available with 100-grain full-metal case and a 90-grain soft-point in addition to the 115-grain. The 80-grain did not come until recent years. Powders in the smokeless class suitable for reloading in this caliber include the old Du Pont Smokeless Rifle Powder #1, Kings Smokeless Rifle Powder #2—which was loaded bulk-for-bulk with 20 grains of black powder—and the later powders such as Gallery Rifle #75, Sporting Rifle #80, #1204, #4227, and Hercules #2400. The last three powders do not perform very well in handgun loads. This cartridge was originally designed for the Winchester and Marlin Repeating Rifle and is a companion to the .25/20, .38/40 and .44/40 cartridge—each having approximately the same overall length. In loading it, do not exceed 15,000 pounds pressure for handgun use or 30,000 pounds for rifle use.

.32/20 WCF

(Rifle Loads; see page 404 for Handguns)

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
80	MC	.217	2400	8.0	1020		Her.
"	"	"	"	10.0	1370	16,500	"
"	"	"	"	13.0	1845	28,000	"
"	"	"	Sharpshooter	14.5	2100[1]	24,400	"
"	"	"	Unique	5.5	1540	16,100	"
"	"	"	"	6.6	1800	22,000	"
"	"	.200	SR 80	8.5	1600		Du P.
"	"	"	"	12.5	1930		"
"	"	"	1204	11.0	1560		"
"	"	"	"	15.8	2000		"
"	"	.217	Sharpshooter	6.0	1010		Her.
"	"	"	"	10.0	1650	18,500	"
"	"	"	"	12.1	1980	28,000	"
"	"	"	Lightn'g	10.0	1200		"
"	"	"	"	12.0	1460	16,800	"
"	"	"	"	15.8	1960	28,000	"
"	"	.20	4227	13.0	1710		Du P.
"	"	"	"	17.0	2220		"
90	Lead	.220	2400	6.0	890		Her.
"	"	"	"	9.0	1390	16,900	"
"	"	"	"	11.6	1780	28,000	"
"	"	"	Unique	6.0	1680	19,400	"
"	"	.250	SR 80	7.0	1170		Du P.
"	"	"	"	9.0	1510		"
"	"	.220	Sharpshooter	6.0	1120		Her.
"	"	"	"	9.0	1555	16,600	"
"	"	"	"	11.6	1940	28,000	"
"	"	"	Lightn'g	8.0	1025		"
"	"	"	"	13.0	1600	19,000	"
"	"	"	"	15.3	1880	28,000	"
100	MC	.260	2400	8.0	1050		"
"	"	"	"	9.0	1180	17,500	"
"	"	"	"	11.5	1670	28,000	"
"	"	"	Unique	4.5	1250	13,500	"
"	"	"	"	6.0	1560	22,000	"
"	"	.250	SR 80	6.9	1235		Du P.
"	"	"	"	11.5	1700		"
"	"	.260	Sharpshooter	8.0	1320		Her.
"	"	"	"	9.0	1500	20,000	"
"	"	"	"	10.7	1770	28,000	"
"	"	"	Lightn'g	9.0	1090		"
"	"	"	"	12.0	1530	19,600	"
"	"	"	"	14.3	1830	28,000	"
"	Lead	.249	2400	6.0	845		"
"	"	"	"	10.0	1415	13,800	"
"	"	"	"	11.8	1730	28,000	"
"	"	"	Unique	5.5	1500	18,000	"
"	"	.225	SR 80	7.0	1210		Du P.
"	"	"	"	8.6	1400		"
"	"	.249	Sharpshooter	6.0	1060		Her.
"	"	"	"	10.0	1515	16,400	"
"	"	"	"	11.7	1850	28,000	"
"	"	"	Lightn'g	7.0	885		"
"	"	"	"	12.0	1480	17,000	"
"	"	"	"	14.8	1815	28,000	"
111	GC	.364	2400	7.0	1090		"
"	"	"	"	9.0	1375	18,900	"
"	"	"	"	11.0	1670	28,000	"

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
111	GC	.364	Unique	4.0	1195	14,000	Her.
"	"	"	"	5.4	1475	22,000	"
"	"	"	Sharpshooter	8.0	1420	18,000	"
"	"	"	"	7.0	1280		"
"	"	"	"	10.1	1720	28,000	"
115	MC	.345	2400	8.0	970		"
"	"	"	"	9.0	1200	17,800	"
"	"	"	"	10.8	1555	28,000	"
"	"	"	Unique	4.0	1000	11,600	"
"	"	"	"	5.4	1340	22,000	"
"	"	"	"	7.0	1575	27,000	"
"	"	"	Sharpshooter	11.7	1684[1]	25,000	"
"	"	"	Lightn'g	14.1	1683[1]	25,000	"
"	"	.350	SR 80	6.5	985		Du P.
"	"	"	"	9.3	1325		"
"	"	"	1204	10.0	1355		"
"	"	"	"	13.0	1675		"
"	"	.345	Sharpshooter	7.0	1110		Her.
"	"	"	"	8.0	1280	17,500	"
"	"	"	"	10.1	1610	28,000	"
"	"	"	Lightn'g	8.0	820		"
"	"	"	"	11.0	1280	18,900	"
"	"	"	"	13.3	1540	28,000	"
"	"	.35	4227	10.0	1400		Du P.
"	"	"	"	13.5	1760		"
"	Lead	.314	2400	7.0	1015		Her.
"	"	"	"	9.0	1390	19,000	"
"	"	"	"	11.2	1670	28,000	"
"	"	"	Unique	5.5	1475	20,000	"
"	"	.350	SR 80	6.5	1215		Du P.
"	"	"	"	7.3	1360		"
"	"	.314	Sharpshooter	7.0	1210		Her.
"	"	"	"	9.0	1500	19,000	"
"	"	"	"	11.0	1780	28,000	"
"	"	"	Lightn'g	10.0	1260		"
"	"	"	"	12.0	1480	19,200	"
"	"	"	"	14.1	1720	28,000	"

[1] Velocity with corrosive primer.

.32/35 STEVENS CARTRIDGE

This is one of our old-time super-accurate cartridges; it was designed and first placed on the market in the early 1880's by the J. Stevens Arms & Tool Co., and all of their higher-grade "tip-up-action" rifles were furnished for this cartridge. The introduction of the .32/40 and .32-caliber Ideal cartridges caused the arms makers to abandon the .32/35 to a great extent, but it was still preferred by many riflemen on account of its very fine accuracy up to 300 yards combined with its light recoil.

The cartridge was supplied loaded with 35 grains of Fg black powder and a 153-grain grooved bullet; also with the same charge of powder and a 165-grain paper-patched bullet. The bullets for this cartridge are .311 inch diameter, and it really should have been called a .31 caliber. The overall length of the factory cartridge loaded with the 153-grain lubricated bullet was 2 7/16 inches, while those loaded with the 165-grain paper-patched bullet varied from 2 7/16 to 2½ inches.

The finest accuracy obtained with this cartridge is by seating either the 153-grain or the 165-grain bullet in the breech about 1/16 inch ahead of the case, using a bullet seater or dummy cartridge for this purpose. The case containing the powder with card, blotting paper, or felt wad over the powder was placed in the chamber behind the breech-seated bullet. Loaded in this way, with a charge of 5 grains bulk Du Pont #1 Rifle Smokeless, or Du Pont Smokeless Shotgun powder, the rest of the case filled with Kentucky Rifle Fg black powder, or Kings Semi-Smokeless Fg, and card or felt wad over the powder, the .32/35 cartridge in Maynard and Ballard rifles has made many 10-shot groups at 100 and 200 yards rest shooting that cannot be equaled by the great majority of our toasted high-power rifles of the present day. Away back in 1886 this cartridge, in Maynard rifles, when shot by an expert, would make 10-shot groups at 100 yards rest that would all hit—or be covered by—a dime. Numerous such groups are recorded in the predecessor of *The American Rifleman*—"*The Rifle.*"

I have personally owned several rifles of this caliber and all were among the most accurate I have yet owned.

A favorite load for this cartridge among the experts of the 1890's was 13 to 14 grains weight of Du Pont #1 Rifle Smokeless powder, or the same weight of Du Pont Schuetzen smokeless, a card or felt wad on the powder and the 153- or 165-grain bullet breech-seated about 1/16 inch ahead of the case. If it was desired to seat the bullet in the case, the charge was reduced about 3 grains weight. Most riflemen used the .32/35 "Everlasting" cases for rifles of this caliber, as these were turned from a solid brass rod and would practically last a lifetime if properly cared for.

Present-day smokeless powders best adapted to this cartridge are: 12 to 14 grains weight Du Pont Shotgun Smokeless powder, card wad on the powder and bullet breech-seated as above; 12 or 13 grains weight Du Pont #80 Smokeless, or about the same charge of Du Pont #1204. Bullets should be cast about 1 to 25 lead and tin for use with either of these loads. Still another very accurate load for 200 yards shooting is, 5 grains bulk Du Pont Shotgun Smokeless as a priming charge and the rest of the case filled with Kings Semi-Smokeless Fg, card wad and 165-grain grooved bullet cast 1 to 40, or 1 to 50. Bullets should be lubricated with a rather soft lubricant for this last load, or with a harder, higher-melting lubricant for the loads of #80 and #1204 powders.

N. H. Roberts

.32 REMINGTON

This is another of the Remington Autoloading series, and compares, generally speaking, to the

.32 Winchester Special. It is a rimless cartridge adapted both to the autoloading and slide-action rifles, and also to certain models of the Remington .30 bolt-action. The cartridge can be readily reloaded and a wide variety of bullets is available.

.32 Remington

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 22-in. Barrel	Breech Pressure	Recommended by
110	MC	.192	HiVel 2	15.0	1150		Her.
"	"	"	"	26.0	1845	18,500	"
"	"	"	"	35.2	2520	40,000	"
"	"	"	HiVel 3	12.0	1110		"
"	"	"	"	22.0	1870	19,500	"
"	"	"	"	29.7	2460	40,000	"
"	"	.200	3031	33.0	2245		Du P.
"	"	"	"	38.0	2500		"
"	"	"	17½	33.0	1975		"
"	"	"	"	39.0	2500		"
"	"	"	1204	20.0	2000		"
"	"	"	SR 80	15.0	1775		"
"	"	"	"	18.0	2050		"
"	"	.192	Unique	9.0	1550	17,600	Her.
"	"	"	"	13.2	1990	32,000	"
"	"	"	Lightn'g	30.6	2610[1]	36,800	"
"	"	"	Unique	15.5	2240	38,000	"
"	"	"	Sharpshooter	27.5	2617[1]	36,700	"
"	"	"	"	16.0	1780	16,000	"
"	"	"	"	22.8	2400	32,000	"
"	"	"	Lightn'g	20.0	1720		"
"	"	"	"	26.0	2200	24,600	"
"	"	"	"	31.7	2595	40,000	"
"	"	"	2400	15.0	1745	16,800	"
"	"	"	"	20.6	2265	32,000	"
"	"	.20	4198	26.0	2285		Du P.
"	"	"	"	34.0	2730		"
170	"	.456	HiVel 2	14.0	1080		Her.
"	"	"	"	22.0	1490	20,600	"
"	"	"	"	30.5	2080	40,000	"
"	"	"	HiVel 3	10.0	1020		"
"	"	"	"	18.0	1500	19,100	"
"	"	"	"	26.0	2090	40,000	"
"	"	"	Unique	8.0	1090	18,400	"
"	"	"	"	11.0	1425	32,000	"
"	"	"	Her. 300	34.8	2170[1]	38,000	"
"	"	"	Lightn'g	24.2	1944	33,000	"
"	"	.475	3031	29.0	1930		Du P.
"	"	"	"	34.0	2220		"
"	"	.375	SR 80	15.0	1300		"
"	"	"	17½	33.4	2100		"
"	"	"	1204	18.0	1600		"
"	"	"	16	32.3	2112[1]		"
"	"	"	"	34.0	2275[1]		"
"	"	.456	Sharpshooter	12.0	1215	15,200	Her.
"	"	"	"	17.6	1740	32,000	"
"	"	"	Lightn'g	13.0	1060		"
"	"	"	"	19.0	1485	20,500	"
"	"	"	"	26.5	2020	40,000	"
"	"	"	2400	13.0	1340	15,200	"
"	"	"	"	18.0	1825	32,000	"
"	"	.475	4198	21.0	1800		Du P.
"	"	"	"	27.0	2130		"
"	Lead	.400	2400	18.0	1800	24,500	Her.

[1] Velocity with corrosive primer.

.32 WINCHESTER SPECIAL

This particular cartridge is entirely different from the .32 WCF or .32/20 as the latter is generally called. It is very similar in general appearance to the .30 WCF or .30/30, but has a slightly larger bullet diameter. It can be reloaded readily with conventional types of tools of proper dimensions. A wide variety of bullets is available to fit it.

.32 Winchester Special

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
110	MC	.192	2400	13.0	1460		Her.
"	"	"	"	15.0	1720	14,300	"
"	"	"	"	16.0	1835	17,200	"
"	"	"	"	18.4	2080	28,000	"
"	"	"	"	20.0	2210	35,000	"
"	"	"	HiVel 2	22.0	1480		"
"	"	"	"	29.0	2100	20,000	"
"	"	"	"	35.4	2525	35,000	"
"	"	"	HiVel 3	18.0	1460		"
"	"	"	"	26.0	2170	20,300	"
"	"	"	"	31.6	2620	35,000	"
"	"	"	Unique	11.0	1775	17,000	"
"	"	"	"	14.0	2060	28,000	"
"	"	"	"	15.2	2250	39,000	"
"	"	.200	3031	32.0	2050		Du P.
"	"	"	"	37.0	2325		"
"	"	"	17½	33.3	1910		"
"	"	"	"	39.0	2385		"
"	"	"	SR 80	15.0	1740		"
"	"	"	"	18.0	2000		"
"	"	"	1204	25.0	2210		"
"	"	"	18	30.0	1760[1]		"
"	"	"	"	40.0	2500[1]		"
"	"	.192	Lightn'g	20.0	1800		Her.
"	"	"	"	25.0	2130		"
"	"	"	"	29.8	2510		"
"	"	"	Sharpshooter	17.0	1940	15,800	"
"	"	"	"	21.6	2340	28,000	"
"	"	.20	4198	29.0	2350		Du P.
"	"	"	"	36.0	2775		"
"	"	"	4320	35.0	2140		"
"	"	"	"	40.0	2375		"
117	Lead	.265	2400	12.0	1400		Her.
"	"	"	"	16.0	1800	16,400	"
"	"	"	"	17.0	1890	18,600	"
"	"	"	"	22.2	2315	35,000	"
"	"	.325	SR 80	9.5	1200		Du P.
"	"	.265	Sharpshooter	16.0	1780	16,000	Her.
"	"	"	"	21.0	2200	28,000	"
"	"	"	Lightn'g	16.0	1405		"
"	"	"	"	23.0	1920	18,800	"
"	"	"	"	30.0	2410	35,000	"
150	"	.437	Unique	10.0	1575	20,000	"
165	MC	.417	2400	12.0	1200		"
"	"	"	"	14.0	1400	15,700	"
"	"	"	"	15.0	1500	19,000	"
"	"	"	"	17.3	1675	28,000	"
"	"	"	"	18.7	1770	35,000	"
"	"	"	HiVel 2	18.0	1160		"
"	"	"	"	25.0	1640	20,000	"
"	"	"	"	31.4	2100	35,000	"
"	"	"	HiVel 3	18.0	1390		"
"	"	"	"	22.0	1700	19,000	"
"	"	"	"	28.4	2200	35,000	"
"	"	"	Unique	9.0	1225	17,000	"
"	"	"	"	12.0	1540	28,000	"
"	"	"	Sharpshooter	15.0	1530	18,400	"
"	"	"	"	19.2	1885	28,000	"
"	"	"	Lightn'g	16.0	1270		"
"	"	"	"	21.0	1615	19,300	"
"	"	"	"	26.6	2075	35,000	"
170	MC BT	.400	3031	28.0	1810		Du P.
"	"	"	"	33.5	2190		"
"	MC	.350	"	34.0	2145		"
"	"	.400	17½	32.0	1985		"
"	"	"	"	36.0	2210		"
"	"	"	SR 80	15.2	1460		"
"	"	"	1204	23.0	1860		"
"	"	"	18	30.0	1870[1]		"
"	"	"	"	32.8	2060[1]		"
"	"	"	16	30.8	2075[1]		"
"	"	"	"	33.5	2250[1]		"
"	"	.379	2400	10.0	960		Her.
"	"	"	"	14.0	1400	15,500	"
"	"	"	"	15.0	1500	18,600	"
"	"	"	"	17.3	1680	28,000	"
"	"	"	"	18.7	1785	35,000	"
"	"	"	HiVel 2	18.0	1140		"
"	"	"	"	25.0	1640	19,000	"
"	"	"	"	32.0	2120	35,000	"
"	"	"	HiVel 3	16.0	1240		"
"	"	"	"	23.0	1820	19,700	"
"	"	"	"	28.6	2240	35,000	"
"	"	"	Unique	9.0	1265	17,200	"
"	"	"	"	11.2	1460	28,000	"
"	"	"	Sharpshooter	21.6	2000	33,000	"
"	"	"	Lightn'g	25.9	2025[1]	37,000	"

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
170	MC	.379	Her.300	34.7	2140[1]	32,100	Her.
"	"	"	"	35.0	2175[1]	34,000	"
"	"	"	Pyro	31.0	2000[1]	35,000	"
"	"	"	15	32.0	1950[1]	29,000	"
"	"	"	Lightn'g	14.0	1100		"
"	"	"	"	20.0	1560	18,500	"
"	"	"	"	27.0	2040	35,000	"
"	"	"	Sharpshooter	14.0	1440	14,400	"
"	"	"	"	18.9	1835	28,000	"
"	"	.40	4198	23.0	1820		Du P.
"	"	"	"	30.0	2710		"
"	"	"	4320	32.0	1870		"
"	"	"	"	36.5	2135		"
"	Lead	.387	2400	16.0	1560	16,600	Her.
"	"	"	HiVel 2	23.0	1550	15,500	"
"	"	"	HiVel 3	19.0	1540	15,100	"
"	"	.425	SR 80	15.2	1590		Du P.
"	"	"	GR 75	12.0	1420		"
"	"	.387	Unique	9.0	1350	17,500	Her.
"	"	"	Lightn'g	17.0	1400	13,300	"
"	"	"	Sharpshooter	13.0	1415	12,600	"

[1] Velocity with corrosive primer.

.32 WINCHESTER SELF-LOADING

This is a short semi-rimmed cartridge for the Winchester Autoloading rifle. It is not extremely powerful nor a good number for all-round shooting, although it performs excellently on small game, varmints, and so forth, at short range. Due to the type of autoloading action, the cartridge is not extremely flexible, and velocities around the standard must be maintained.

.32 Winchester Self-Loading

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 22-in. Barrel	Breech Pressure	Recommended by
155	Lead	.271	2400	8.0	1025		Her.
"	"	"	"	9.5	1270	21,500	"
"	"	"	"	12.5	1650	30,000	"
"	"	"	Unique	4.0	1000	11,500	"
"	"	"	"	5.9	1305	24,000	"
"	"	"	Sharpshooter	7.0	1040		"
"	"	"	"	9.0	1295	19,700	"
"	"	"	"	10.0	1550	30,000	"
165	MC	.261	2400	8.5	970		"
"	"	"	"	10.0	1185	18,200	"
"	"	"	"	12.3	1475	30,000	"
"	"	"	Unique	5.0	830	14,000	"
"	"	"	"	6.3	1130	24,000	"
"	"	"	Sharpshooter	11.3	1480	29,000	"
"	"	.275	SR 80	7.0	1030		Du P.
"	"	"	1204	10.5	1110		"
"	"	"	"	12.5	1310		"
"	"	"	"	13.5	1430		"
"	"	.261	Sharpshooter	8.0	950		Her.
"	"	"	"	9.0	1125	16,500	"
"	"	"	Lightn'g	11.0	955		"
"	"	"	"	12.0	1095	16,000	"
"	"	"	"	13.9	1370	30,000	"
"	"	.275	4227	10.0	1170		Du P.
"	"	"	"	12.5	1440		"

.32/40 WINCHESTER-MARLIN AND BALLARD

This cartridge was developed for the old single-shot Ballard rifle in this caliber, and of course as

.32/40 Winchester-Marlin and Ballard

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 26-in. Barrel	Breech Pressure	Recommended by
110		.200	3031	28.0	2155		Du P.
"		"	"	33.0	2245		"
"		"	17½	28.0	1725		"
"		"	"	36.0	2330		"
"		"	4198	20.5	1850		"
"		"	"	24.0	2230		"
125	Lead	.362	2400	9.0	1145		Her.
"	"	"	"	13.0	1680	16,000	"
"	"	"	"	14.5	1855	20,000	"
"	"	"	"	16.4	2020	25,000	"
"	"	"	Unique	7.0	1425	12,500	"
"	"	"	"	9.1	1690	20,000	"
"	"	.350	SR 80	10.0	1250		Du P.
"	"	.362	Lightn'g	12.0	1250		Her.
"	"	"	"	18.0	1725	15,200	"
"	"	"	"	22.2	2060	25,000	"
"	"	"	Sharpshooter	15.6	1945	20,000	"
165	MC	.500	3031	24.0	1835		Du P.
"	"	"	"	28.0	1955		"
"	"	.425	17½	27.0	1750		"
"	"	"	"	31.0	2000		"
"	MC BT	"	"	32.0	2250	Max.	JBS
"	MC	"	SR 80	10.8	1165		Du P.
"	"	"	"	13.1	1415		"
"	"	"	1204	16.0	1415		"
"	"	"	"	19.0	1750		"
"	"	"	16	25.0	1754		"
"	"	"	"	29.0	2100		"
"	"	"	"	30.5	2260	40,000	"
"	"	"	18	24.0	1400		"
"	"	"	"	29.0	1963		"
"	"	"	Du P. 1	17.0	1450		"
"	"	"	21	18.0	1500		"
"	"	"	"	26.5	2000	42,000	"
"	"	.505	2400	9.0	920		Her.
"	"	"	"	11.0	1180	12,500	"
"	"	"	"	12.0	1290	15,000	"
"	"	"	"	13.7	1470	20,000	"
"	"	"	"	15.1	1600	25,000	"
"	"	"	HiVel 2	16.0	1050		"
"	"	"	"	20.0	1390	15,000	"
"	"	"	"	24.2	1750	25,000	"
"	"	"	HiVel 3	13.0	1080		"
"	"	"	"	16.0	1390	15,200	"
"	"	"	"	20.0	1770	25,000	"
"	"	"	Unique	6.0	880	11,600	"
"	"	"	"	8.5	1255	20,000	"
"	"	"	Her. 300	27.2	1762[1]	23,700	"
"	"	"	"	32.0	2100[1]	42,000	"
"	"	"	Lightn'g	20.5	1744	26,500	"
"	"	"	"	24.5	2058	38,000	"
"	"	"	Sharpshooter	12.1	1420	11,500	"
"	"	"	"	14.2	1580	20,000	"
"	"	"	"	16.4	1744	25,000	"
"	"	"	Lightn'g	15.0	1300		"
"	"	"	"	17.0	1485	17,600	"
"	"	"	"	20.0	1726	25,000	"
"	"	.50	4198	17.0	1460		Du P.
"	"	"	"	21.5	1870		"
"	Lead	.508	2400	9.0	1290		Her.
"	"	"	"	12.0	1385	14,800	"
"	"	"	"	13.6	1545	20,000	"
"	"	"	"	14.9	1670	25,000	"
"	"	"	Unique	6.0	1110	12,600	"
"	"	"	"	8.2	1380	20,000	"
"	"	.425	SR 80	9.0	1107		Du P.
"	"	"	"	10.0	1245		"
"	"	"	"	13.2	1427		"
"	"	"	GR 75	6.5	1100		"
"	"	"	"	8.0	1200		"
"	"	.508	Sharpshooter	10.0			Her.
"	"	"	"	13.5	1610	20,000	"
174	GC	"	Lightn'g	21.0			"
185	Lead	.452	2400	8.0	940		"
"	"	"	"	11.0	1250	14,400	"
"	"	"	"	12.8	1435	20,000	"
"	"	"	"	14.0	1540	25,000	"
"	"	"	HiVel 3	12.0	1105		"
"	"	"	"	16.0	1430	16,600	"
"	"	"	"	19.4	1700	25,000	"
"	"	"	Lightn'g	11.0	1080		"
"	"	"	"	15.0	1380	15,200	"
"	"	"	"	19.2	1660	25,000	"
"	"	"	Sharpshooter	13.7	1550	20,000	"

[1] Velocity with corrosive primer.

a black-powder number. It was in those days—and is today—one of the most accurate cartridges in its class, and with suitable loading can be made to shoot equal to the best of Springfield Match barrels with precision loadings. The original factory loadings call for a 165-grain lead bullet with 40 grains of Fg black powder, the original bullet being 1 part of tin to 40 parts lead. In the old-type rifle barrels only cast bullets should be used, and these with black, semi-smokeless or bulk smokeless powders. With more recent barrels various other smokeless powders can be used with metal-jacketed bullets. The cartridge is an excellent performer over a wide velocity range. A great many assorted rifles have been built to handle this cartridge, the repeating Winchester and Marlin series closely following its success in the Ballard number. The accuracy range is approximately 500 yards under favorable conditions. The 1899 Marlin catalog recommended 16 to 17 grains of Du Pont Smokeless Rifle Powder #1 and bulk-for-bulk with Kings Smokeless Rifle Powder #4 (equivalent of 40 grains of black powder).

.33 WCF

The .33 was the last remaining number in the old Model 1886 Winchester rifle family. The .33, effective January 1, 1936, became an obsolete number, but since many thousands of rifles have been manufactured for it and are still in use, the cartridge will be maintained for many years to come by various loading companies. It is an excellent heavy-power rifle suitable for all North American game up to and including moose, and the sturdy construction of the cartridge case makes for excellent reloading, but the large case requires frequent full-length resizing. According to Winchester factory records, the first .33 WCF rifle was assembled in August, 1902.

.33 Winchester

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
140	Lead	.297	Unique	10.0	1545	13,100	Her.
145	"	.275	SR 80	12.0	1160		Du P.
195	GC	.315	HiVel 2	18.0	1200		Her.
"	"	"	"	32.0	1940	21,600	"
"	"	"	"	44.0	2455	42,000	"
"	"	"	HiVel 3	18.0	1360		"
"	"	"	"	28.0	2000	21,700	"
"	"	"	"	36.8	2425	42,000	"
"	"	"	Unique	11.0	1440	16,800	"
"	"	"	"	16.8	1885	34,000	"
"	"	"	Lighten'g	18.0	1440		"
"	"	"	"	28.0	1960	21,400	"
"	"	"	"	37.4	2445	42,000	"
"	"	"	Sharpshooter	20.0	1860	20,000	"
"	"	"	"	26.6	2255	34,000	"
195	GC	.315	2400	18.0	1640	15,600	Her.
"	"	"	"	25.2	2100	34 000	"
"	Lead	.475	SR 80	17.0	1597		Du P.
200	MC	.350	3031	37.0	2050		"
"	"	"	"	42.0	2260		"
"	"	.275	17½	42.0	2040		"
"	"	"	"	47.0	2260		"
"	"	"	SR 80	18.5	1600		"
"	"	"	18	34.0	1775[1]		"
"	"	"	"	43.0	2280[1]		"
"	"	"	16	38.0	2056[1]		"
"	"	"	"	41.0	2230[1]		"
"	"	.288	HiVel 2	20.0	1180		Her.
"	"	"	"	35.0	2000	23,700	"
"	"	"	"	43.2	2445	42,000	"
"	"	"	HiVel 3	17.0	1305		"
"	"	"	"	31.0	2100	25,000	"
"	"	"	"	39.0	2555	42,000	"
"	"	"	Unique	11.0	1205	16,800	"
"	"	"	"	15.8	1585	34,000	"
"	"	"	Sharpshooter	25.6	2036	27,000	
"	"	"	Her. 300	44.3	2253	28,900	"
"	"	"	Sharpshooter	20.0	1750	20,100	"
"	"	"	"	26.4	2140	34,000	"
"	"	"	Lightn'g	15.0	1080		"
"	"	"	"	27.0	1815	21,000	"
"	"	"	"	36.6	2355	42,000	"
"	"	"	2400	19.0	1640	15,700	"
"	"	"	"	26.4	2115	34,000	"
"	"	.35	4320	38.0	2000		Du P.
"	"	"	"	44.5	2225		"
"	"	"	4064	41.0	2010		"
"	"	"	"	46.0	2260		"
"	"	"	4198	24.0	1650		"
"	"	"	"	32.0	2140		"

[1] Velocity with corrosive primer.

.348 WCF

The .348 Winchester cartridge was designed for the Model 71 lever-action rifle, which made its appearance in January 1936. This cartridge was born around 1933 when the Winchester boys began experimental work with a view to improving the old Model 1886 rifle with its .33 WCF cartridge. The new .348 has a much larger-capacity cartridge case, bigger in diameter; with the single exception of the .405 Winchester, it is the most powerful lever-action in the United States today. It is a bit too new to give a great deal of loading information, but is designed properly and should be a successful cartridge for this purpose. It was originally intended to call this the .34 WCF, and the author first saw these cartridges so marked back in 1933 on a visit to the Winchester plant. The factory loadings included two weights of bullets, the 150-grain being the best for target purposes up to 200 yards, and the 200-grain being suitable for target work at ranges beyond this. Regardless of the statements of a great many writers, this cartridge will perform to within 2-inch groups at 100 yards with standard factory ammunition, and it is quite possible that handloads will improve this to a certain extent. Powders suitable for this cartridge are chiefly the new Du Pont #4064 and #3031 together with their counterparts, #15½ and #17½.

.348 Winchester

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt Chg. Grs.	M V in 26-in. Barrel	Breech Pressure	Recommended by
150	Soft Point	.25	4198	35.5	2365		Du P.
"	"	"	"	39.8	2590		"
"	"	"	3031	50.0	2600		"
"	"	"	"	54.2	2775		"
"	"	"	4320	54.0	2640		"
"	"	"	"	58.0	2795		"
"	"	"	4064	55.5	2700		"
"	"	"	"	58.5	2835		"
200	"	.45	4198	34.5	2100		"
"	"	"	"	38.0	2275		"
"	"	"	3031	43.0	2200		"
"	"	"	"	49.0	2450		"
"	"	"	4320	46.0	2235		"
"	"	"	"	52.0	2470		"
"	"	"	4064	48.5	2315		"
"	"	"	"	53.6	2535		"

.35 WINCHESTER SELF-LOADING

This is the companion number to the .32 Winchester Self-Loading and is suitable chiefly for small game. Comments made on the .32 S.L. apply equally to the .35. Incidentally, this cartridge case is of the semi-rimmed variety and can be used for handloading purposes in the .38 Special Revolver. Do not, however, use the regular factory load in such arms, as the small, heavy, metal-jacketed bullet, with the high pressure developed, is likely to be disastrous to the weapon. Cases have been reloaded satisfactorily by the author with standard .38 Special bullets after the initial expansion.

.35 Winchester Self-Loading

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 22-in. Barrel	Breech Pressure	Recommended by
165	Lead	.307	2400	8.0	920		Her.
"	"	"	"	10.0	1180	17,500	"
"	"	"	"	13.2	1560	32,000	"
"	"	"	Unique	4.0	950	12,500	"
"	"	"	"	6.3	1310	26,000	"
180	MC	.253	2400	8.0	820		"
"	"	"	"	10.0	1000	20,300	"
"	"	"	"	12.9	1420	32,000	"
"	"	"	Unique	5.0	860	17,000	"
"	"	"	"	6.3	1100	26,000	"
"	"	"	Sharpshooter	8.0	915		"
"	"	"	"	9.0	1040	20,000	"
"	"	"	"	11.5	1360	32,000	"
"	"	"	Lightn'g	11.0	885		"
"	"	"	"	12.0	1005	18,600	"
"	"	"	"	13.0	1125	22,400	"
"	"	.250	SR 80	7.0	1000		Du P.
"	"	"	"	8.0	1125		"
"	"	"	1204	13.0	1140		"
"	"	"	"	15.0	1385		"
"	"	"	Unique	8.0	1360[1]	35,000	Her.
"	"	"	Lightn'g	15.4	1410[1]	31,000	"
"	"	"	Sharpshooter	12.6	1398[1]	29,000	"
"	"	.275	4227	10.5	1120		Du P.
"	"	"	"	13.5	1440		"

[1] Velocity with corrosive primer.

.35 REMINGTON AUTO

This is another member of the Remington Autoloading series, also used in the Remington slide-action rifle. It is by far the most powerful number of the Remington series and the most desirable for deer shooting. The short rimless case, with very little neck and shoulder, is, however, rather difficult for handloading, and it must not be loaded with slipshod tools. Resizing dies must be made exactly to fit it, if best results are to be obtained.

.35 Remington

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 22-in. Barrel	Breech Pressure	Recommended by
150	MC	.201	2400	22.0	1938		Her.
"	"	"	"	26.0	2196	27,900	"
"	"	"	"	30.3	2465	40,000	"
"	"	"	HiVel 2	38.5	2358	34,000	"
"	"	"	Lightn'g	33.2	2300[1]	35,200	"
"	"	"	Sharpshooter	30.0	2460[1]	38,200	"
"	"	"	Unique	10.0	1505	14,100	"
"	"	"	"	13.9	1870	26,000	"
"	"	.200	3031	35.0	1970		Du P.
"	"	"	"	40.5	2230		"
"	"	"	17½	35.0	1725		"
"	"	"	"	41.0	2120		"
"	"	"	1204	27.0	1990		"
"	"	"	"	35.0	2450		"
"	"	"	SR 80	15.0	1525		"
"	"	"	"	21.0	1925		"
"	"	.213	Lightn'g	22.0	1660		Her.
"	"	"	"	28.0	2045	21,800	"
"	"	"	"	32.8	2340	32,000	"
"	"	"	Sharpshooter	20.0	1945	19,600	"
"	"	"	"	23.4	2215	26,000	"
"	"	"	2400	17.0	1720	15,000	"
"	"	"	"	20.8	1980	26,000	"
"	"	.20	4198	28.0	2050		Du P.
"	"	"	"	36.0	2400		"
158	Lead	.288	Unique	11.0	1620	18,500	Her.
170	MC	.318	"	9.0	1280	13,900	"
"	"	"	"	12.8	1680	26,000	"
"	"	"	Lightn'g	20.0	1440		"
"	"	"	"	26.0	1865	22,000	"
"	"	"	"	30.7	2150	32,000	"
"	"	"	Sharpshooter	17.0	1640	15,500	"
"	"	"	"	21.6	2005	26,000	"
"	"	"	2400	16.0	1510	13,800	"
"	"	"	"	20.4	1890	26,000	"
200	"	.300	3031	34.0	1870		Du P.
"	"	"	"	39.0	2130		"
"	"	"	SR 80	20.0	1650		"
"	"	"	17½	36.5	1725		"
"	"	"	"	39.5	2025		"
"	"	"	"	40.0	2040		"
"	"	"	1204	25.0	1760		"
"	"	"	"	31.0	2090		"
"	"	"	18	35.0	1760[1]		"
"	"	"	"	38.8	2000[1]	36,000	"
"	"	"	"	41.0	2170[1]		"
"	"	"	16	30.0	1508[1]		"
"	"	"	"	37.0	2000[1]	31,000	"
"	"	"	"	41.0	2225[1]	36,700	"
"	"	"	21	33.5	2000[1]		"
"	"	"	GR 75	13.0	1360[1]		"
"	"	.285	2400	20.0	1680		Her.
"	"	"	"	24.0	1910	28,800	"
"	"	"	"	28.0	2135	40,000	"
"	"	.308	Unique	9.0	1230	14,000	"
"	"	"	"	12.5	1530	26,000	"
"	"	"	Sharpshooter	16.0	1535	15,500	"
"	"	"	"	21.0	1885	26,000	"
"	"	"	Lightn'g	18.0	1335		"
"	"	"	"	26.0	1800	32,500	"
"	"	"	"	30.6	2040	32,000	"
"	"	"	Her. 300	41.0	2050[1]	35,000	"
"	"	"	HiVel 2	35.5	2100[1]	37,200	"
"	"	"	Sharpshooter	25.7	1960[1]	33,000	"
"	"	"	Lightn'g	30.3	2000[1]	35,000	"
"	"	"	2400	16.0	1470	15,600	"
"	"	"	"	20.5	1800	26,000	"
"	"	.30	4198	24.0	1700		Du P.
"	"	"	"	32.0	2045		"
"	GC	.400	SR 80	22.0	1852		"
"	"	"	GR 75	13.0	1400		"

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt Chg. Grs.	M V in 22-in. Barrel	Breech Pressure	Recommended by
200	GC	.400	GR 75	16.0	1560		Du P.
"	"	.358	Unique	8.0	1230	12,200	Her.
"	"	"	"	12.3	1580	26,000	"
"	"	"	Sharpshooter	15.0	1525	15,200	"
"	"	"	"	19.9	1870	26,000	"
"	"	"	Lightn'g	18.0	1400		"
"	"	"	"	24.0	1750	21,000	"
"	"	"	"	29.2	2040	32,000	"
"	"	"	2400	15.0	1465	14,900	"
"	"	"	"	19.9	1820	26,000	"
206	Lead	.325	SR 80	11.0	1170		Du P.
"	"	"	"	16.5	1560		"
225	GC	.375	1204	17.0	1345		"
"	"	"	"	22.0	1800		"
274	"	.600	"	18.0	1325		"
"	"	"	"	21.0	1525		"

[1] Velocity with corrosive primer.

.35 WINCHESTER

This is the big-caliber gun, somewhat more powerful than the old .33, and designed for use in the Model 1895 action. The old Remington-Lee was also made in this caliber. The rimmed case is of a bottle-neck variety and reloads quite readily when standard bullets only are used. Various semi-pointed types perform excellently.

.35 Winchester

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
165	Lead	.300	SR 80	13.5	1186		Du P.
"	"	"	Unique	7.0	1200	7,200	Her.
"	"	"	75	9.5	1180		Du P.
200	MC	.288	HiVel 2	28.0	1520		Her.
"	"	"	"	36.0	1900	22,000	"
"	"	"	"	49.0	2520	45,000	"
"	"	"	HiVel 3	24.0	1520		"
"	"	"	"	30.0	1890	21,000	"
"	"	"	"	40.0	2400	45,000	"
"	"	"	Unique	14.0	1560	19,600	"
"	"	"	"	19.4	1870	36,000	"
"	"	"	Lightn'g	22.0	1500		"
"	"	"	"	30.0	1860	21,200	"
"	"	"	"	42.4	2185	45,000	"
"	"	"	Sharpshooter	23.0	1840	20,700	"
"	"	"	"	29.6	2200	36,000	"
"	"	.300	3031	45.0	2195		Du P.
"	"	"	"	51.0	2465		"
"	"	"	17½	40.0	1850		"
"	"	"	"	53.0	2460		"
"	"	.288	2400	22.0	1748	18,000	Her.
"	"	"	"	28.3	2070	36,000	"
220	WTCW	.330	HiVel 2	47.5	2400	45,000	"
"	Lead	.300	SR 80	17.5	1400		Du P.
"	"	"	GR 75	14.0	1330		"
"	"	"	"	17.5	1450		"
240	GC	"	Lightn'g	34.0	1950[1]		Her.
250	MC	.333	HiVel 2	28.0	1370		"
"	"	"	"	34.0	1680	22,200	"
"	"	"	"	47.0	2345	45,000	"
"	"	"	HiVel 3	22.0	1335		"
"	"	"	"	30.0	1770	23,500	"
"	"	"	"	38.6	2235	45,000	"
"	"	"	Unique	12.0	1160	15,000	"
"	"	"	"	17.7	1560	36,000	"
"	"	"	Sharpshooter	21.0	1540	20,500	"
"	"	"	"	28.2	1935	36,000	"
"	"	"	Lightn'g	22.0	1280		"
"	"	"	"	28.0	1600	21,500	"
"	"	"	"	39.8	2205	45,000	"
"	"	"	Her. 300	48.5	2200[2]	39,000	"
"	"	"	Her. 308	46.0	2150[2]	42,000	"

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt Chg. Grs	M V in 24-in. Barrel	Breech Pressure	Recommended by
250	MC	.350	3031	40.0	1935		Du P.
"	"	"	"	42.0	2025		"
"	"	"	"	49.0	2320		"
"	"	.300	SR 80	18.0	1350		"
"	"	.350	17½	38.0	1690		"
"	"	"	"	49.0	2220		"
"	"	"	20	46.0	2150[1]	42,000	"
"	"	"	"	48.0	2300[1]		JBS
"	"	"	HiVel 2	46.0	2300		"
"	"	"	16	45.6	2200[1]		Du P.
"	"	"	"	47.3	2250[2]		"
"	"	"	"	47.5	2280[2]	37,800	"
"	"	"	15	49.5	2140[2]	41,400	"
"	"	"	18	37.0	1650[1]		"
"	"	"	"	42.0	1870[1]		"
"	"	"	"	46.0	2150[1]		"
"	"	"	"	48.5	2200[1]		"
"	"	.333	2400	20.0	1375	17,500	Her.
"	"	"	"	26.4	1740	36,000	"
"	"	.35	4198	30.0	1825		Du P.
"	"	"	"	37.0	2105		"
"	"	"	4064	44.0	1940		"
"	"	"	"	50.0	2190		"
"	"	"	4320	43.0	1920		"
"	"	"	"	51.5	2250		"

[1] Estimated velocity.
[2] Velocity with corrosive primer.

9 MM. MAUSER AND MANNLICHER

This is another of the foreign series of military and sporting cartridges. It is extremely popular in Europe and in recent years has become increasingly so in the United States, so that both Remington and Winchester manufacture their bolt-action rifles to handle this excellent number. It is rather difficult to handload because of the large caliber and short shoulder, and suitable dies must be used for best results.

9 mm. Mauser and Mannlicher

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
280	MC	.375	3031	38.0	1715		Du P.
"	"	"	"	43.0	2010		"
"	"	.350	17½	43.5	1850		"
"	"	"	"	51.0	2190		"
"	"	"	15½	47.5	2000		"
"	"	"	1147	45.0	1860		"
"	"	"	"	49.0	2050		"
"	"	"	18	41.4	1860[1]		"
"	"	"	"	48.0	2185[1]	48,000	"
"	"	"	16	39.4	1850[1]		"
"	"	"	"	49.0	2250[1]	52,000	"
"	"	"	15	45.0	1900[1]		"
"	"	"	SR 80	18.0	1230		"
"	"	"	"	23.0	1460		"
"	SP	.38	4064	46.0	2035		"

[1] Velocity with corrosive primer.

.35 WHELEN

This cartridge was developed by Colonel Townsend Whelen, noted authority, while he was commanding officer of Frankford Arsenal in the early 1920's. Essentially it is the .30/06 cartridge, only case necked to .35 caliber rather than .30 caliber.

.35 Whelen

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 26-in. Barrel	Breech Pressure	Recom- [redacted] by
130	MC ".38 Colt Auto."		SR 80	20.0	1600		OHE
″	″		″	26.0	2020		″
″	″		″	30.0	2300		″
150	MC		″	20.0	1525		″
″	″		″	25.0	1875		″
″	″		″	30.0	2220		″
″	″		3031	56.0	2720		″
″	″		″	60.0	2940		″
″	″		17½	56.0	2600		″
″	″		″	60.0	2850		″
″	″		″	64.0	3100	Max.	″
158	″		SR 80	20.0	1520		″
″	″		″	26.0	1940		″
″	″		″	30.0	2120		″
200	.35 Rem.	.275	17½	53.0	2370[1]		″
″	″	″	″	58.0	2650		Du P.
″	″	″	″	59.0	2700[1]		OHE
″	″	″	″	63.0	2920[1]	Max.	″
″	″	″	″	64.0	2975[1]		Du P.
″	″	″	15½	53.0	2200[1]		OHE
″	″	″	″	56.0	2340[1]		JBS
″	″	″	″	59.0	2470[1]		OHE
″	″	″	″	60.0	2515[2]		JBS
″	″	″	″	61.0	2560[2]		″
″	″	″	″	63.0	2650[2]		OHE
″	″	.300	3031	50.0	2440		Du P.
″	″	″	″	57.0	2670[2]		OHE
″	″	″	″	59.0	2780[2]		JBS
″	″	″	″	60.0	2850[2]		Du P.
″	Lub. SP		17 Lot 1308	55.0	2585[1,3]	58,000[3]	JVH[4]
″	″		15	57.0	2667[1,3]	46,000	″
″	″		″	58.0	2694[1,3]	48,000	″
″	″		″	60.0	2711[1,3]	52,000	″
220	WTCW	.275	″	50.0	2400		″
″	″	″	″	56.0	2600[1]		OHE
″	″	″	″	58.0	2700[1]		″
″	″	″	″	60.0	2825[1]		Du P.
″	″	″	1147	62.0	2595[1]		OHE
″	″	″	″	66.0	2775[1]		″
″	″	″	17½	57.0	2590[1]		″
″	″	″	″	59.0	2690[1]		″
″	″	″	″	61.0	2790[1]	Max.	Du P.
″	″	″	15½	56.0	2420[1]		JBS
″	″	″	″	58.0	2475[1]		OHE
″	″	″	″	60.0	2565[1]		″
″	″	″	″	61.0	2675[1]		JBS
250	.35 Newton	.350	3031	48.0	2275		Du P.
″	″	″	″	55.0	2520[1]		OHE
″	″	″	″	58.0	2680	Max.	Du P.
″	″	″	17½	52.0	2300		″
″	″	″	″	53.0	2390[1]		OHE
″	″	″	″	57.0	2550[1]		″
″	″	″	″	58.0	2565		Du P.
″	″	″	″	59.0	2630[1]	Max.	OHE
″	″	″	1147	58.0	2440[1]		″
″	″	″	″	62.0	2600[1]		″
″	″	″	SR 80	18.0	1225		Du P.
″	″	″	″	25.0	1625		″
″	″	″	15½	55.0	2340[1]		JBS
″	″	″	″	56.0	2380[1]		OHE
″	″	″	″	57.0	2420[1]		JBS
″	″	″	″	58.0	2460[1]		″
″	″	″	″	60.0	2540[1]		OHE
″	″	″	″	61.0	2580[1]		JBS
″	FMJ		17	52.0	2384	47,000	JVH[4]
″	″		″	53.0	2411	50,000	″
″	″		″	55.0	2522	52,000	″
″	OP	.35	4064	53.0	2450		Du P.
″	″	″	″	60.0	2750		″
275	WTCW	.450	3031	46.0	2135		″
″	″	″	″	53.0	2350[1]		OHE
″	″	″	″	56.0	2480[1]		″
″	″	″	″	56.5	2535[1]		Du P.
″	″	.475	17½	52.0	2250[1]		″
″	″	″	″	56.0	2400[1]		″
″	″	″	1147	54.0	2220[1]		OHE
″	″	″	″	60.0	2460[1]	Max.	″
″	″	″	15½	55.0	2290[1]		″
″	″	″	″	57.0	2380[1]		″

[1] Velocity with corrosive primer.
[2] Velocity in 24-inch barrel.
[3] Dangerous pressures.
[4] FA tests for J. V. Howe.

It is an excellent, powerful cartridge, adapted to actions not sufficiently long to handle the foreign series of Magnums. It has never been commercially manufactured, although a number of custom gun-builders will supply the cases. The Western Tool & Copper Works makes an excellent series of bullets designed chiefly for this caliber. The maximum capacity of this case with IMR #15½ powder is 61 grains. Two types of rifling are used—a 12- and 16-inch twist. Light bullets weighing 130 to 200 grains work best in the 12-inch twist up to 200 yards. The 200-, 250- and 275-grain bullets work best in the 12-inch twist at all ranges. J. Bushnell Smith recommends an 18-inch twist for bullets weighing up to 250 grains.

.350 HOLLAND & HOLLAND MAGNUM

This cartridge was actually developed by Griffin & Howe of New York City, despite the name. It is nothing but a necked-down .375 H. & H. case. Designed for a variety of .35-caliber bullets, it did not achieve the anticipated popularity and today it is becoming another "forgotten number."

.350 H. & H. Magnum

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 26-in. Barrel	Breech Pressure	Recommended by
220	WTCW	.250	15½	70.0	2735		Du P.
″	″	″	″	75.0	2910		″
250	Lubaloy	.375	″	65.0	2550		″
″	″	″	″	70.0	2700		″
″	WTCW	″	″	65.0	2500		″
″	″	″	″	72.0	2740		″
275	″	.450	″	64.0	2380		″
″	″	″	″	70.0	2600		″

.35 NEWTON

This cartridge, produced around 1916, was one of the series designed by Charles Newton for use in his own rifle. A great many custom-built arms have been manufactured to handle this particular number, and it is still available as loaded commercially by the Western Cartridge Company. The .35 Newton is a large-capacity case and is capable of extremely heavy loading. Due to the large capacity of the cartridge case, however, it does not lend itself to mid-range loadings with any degree of success. Recoil is a bit too severe for target work when loaded to maximum velocity, particularly when shot from the prone position. However, the cartridge has been used for that purpose and a great many handloaders have had the success with loads well under the maximum velocity and pressure class. Working pressure of this cartridge is around 50,000 pounds.

This .35 Newton is an unusually powerful brute

of a cartridge, comparing at the muzzle with the English .450 Cordite Elephant Rifle. The rifle designed to handle it was about 7¼ to 7½ pounds, a bit too light for comfortable shooting, whereas the English rifle of the double-barrel variety averages around 12 pounds to handle the same amount of recoil. The heavy 250-grain bullet of factory loading has a muzzle velocity of approximately 3000 f.s. and a muzzle energy of about 5000 pounds. These big bullets require a slow twist, and the majority of rifles in this caliber have been built with 1 turn in 14 inches. The Western Tool & Copper Works and Western Cartridge Company both have excellent bullets in the hollow-point variety available in this number.

.35 Newton

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
200	MC	.300	3031	68.0	2625		Du P.
"	"	"	"	78.0	3030		"
"	"	"	17½	70.0	2650		"
"	"	"	"	77.0	2950		"
"	"	"	15½	70.0	2550		"
"	"	"	"	78.0	2850		"
220	WTCW	.275	3031	68.0	2635		"
"	"	"	"	78.0	3000		"
"	"	.250	17½	73.0	2725		"
"	"	"	"	77.0	2850		"
"	"	"	15½	78.0	2775		"
[illegible]	MC "Lubaloy"	.350	3031	62.0	2395		"
"	"	"	"	72.0	2765		"
"	"	"	17½	63.0	2475		"
"	"	"	"	70.0	2600		"
"	"	"	15½	69.0	2430		"
"	"	"	"	77.0	2750		"
"	WTCW	.375	"	77.0	2690		"
"	MC	.350	SR 80	22.0	1240		"
"	"	"	"	29.0	1525		"
275	WTCW	.450	3031	60.0	2265		"
"	"	"	"	70.0	2615		"
"	"	"	17½	68.0	2425		"
"	"	"	"	70.0	2525		"
"	"	.375	15½	70.0	2400		"
"	"	"	"	76.0	2585		"

.351 WINCHESTER SELF-LOADING

This is another of the autoloading rifle calibers designed by Winchester and used only in that firm's particular make of automatic rifle. It is a semi-rimmed cartridge very similar to the .35 Self-Loading, but longer in cartridge case and with a much better bullet and more power. In loading for this, be very careful to maintain standard velocity as in all other autoloading types of rifles. Cast bullets can be used with reasonable success, but should be carefully crimped to avoid jams or setting the bullet back on the powder.

Both the .35 S.L. and the .351 S.L. are approximately the same size as the .38 Special and .357 Magnum. If your chamber is large, you can resize in a .38 Special full-length die.

.351 Winchester Self-Loading

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 20-in. Barrel	Breech Pressure	Recommended by
170	Lead	.318	2400	8.0	825		Her.
"	"	"	"	13.0	1460	20,200	"
"	"	"	"	18.0	1940	44,200	"
"	"	"	Unique	6.0	1170	15,800	"
"	"	"	"	9.6	1600	36,000	"
"	"	"	Sharpshooter	5.0	740		"
"	"	"	"	11.0	1375	21,500	"
"	"	"	"	17.0	1940	42,800	"
180	MC	.265	2400	10.0	1100		"
"	"	"	"	15.0	1530	26,800	"
"	"	"	"	19.0	1870	45,000	"
"	"	"	Unique	10.5	1565	42,000	"
"	"	"	Lightn'g	11.0	850		"
"	"	"	"	15.0	1210	17,200	"
"	"	"	"	18.0	1470	26,200	"
"	"	"	Sharpshooter	9.0	980		"
"	"	"	"	13.0	1420	23,800	"
"	"	"	"	17.1	1870	45,000	"
"	"	.250	SR 80	10.0	1215		Du P.
"	"	"	1204	17.0	1460		"
"	"	"	"	20.5	1775		"
"	"	"	4227	16.0	1510		"
"	"	"	"	19.5	1800		"
"	GC	.325	SR 80	9.0	1235		"
"	"	"	"	11.0	1440		"

.357 ELLIOTT EXPRESS

The .357 Elliott Express is another of the series of rimmed Express cartridges made from a .405 Winchester case necked down by O. H. Elliott & Co., of South Haven, Michigan, as described under the .277 Elliott Express, on page 365.

The .357 Elliott Express uses any standard bullet adapted to the .35 Remington, .35 Newton or .35 Whelen cartridges. The 9 mm. Mauser and some .38 S. & W. Special bullets are used in light loads, if of proper diameter.

The eight-groove barrels, as made by Mr. Elliott, have a bore diameter of .350 inch and a groove diameter of .357 inch. Twist is one turn in twelve inches.

.357 Elliott Express

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 28-in. Barrel	Breech Pressure	Recommended by
220	35 Whelen WT&C	.280	4320	55.0	2500		OHE
"	"	"	"	61.0	2770		"
"	"	"	4064	55.0	2600		"
"	"	"	"	60.0	2820		"
250	Western HP .35 Newton	.350	4320	55.0	2420		"
"	"	"	"	60.0	2670		"
"	"	"	4064	52.0	2420		"
"	"	"	"	59.0	2710		"
275	.35 Whelen WT&C	.400	4320	50.0	2210		"
"	"	"	"	58.0	2540		"
"	"	"	4064	50.0	2325		"
"	"	"	"	56.0	2550		"

.375 HOLLAND & HOLLAND MAGNUM

This is one of the coming heavy-power cartridges in American demand. Originally an Eng-

lish cartridge of the same series as the .275, .300, .350, the .375 has grown rapidly in favor. The Winchester people released their new Model 70 rifle in this caliber late in June, 1937. The ammunition is manufactured in several weights of bullets by both Winchester and Western, Winchester having added it to the line in 1936 and Western several years previously. The .375 is a belted type of cartridge case, but is rather difficult to reload because of the slight shoulder remaining in such a big-bore cartridge. Several shooters have been handloading this with excellent success for a number of years.

A wide variety of bullets is available in this caliber, but only the standard bullets manufactured for this cartridge by the Western and Winchester firms or the Western Tool & Copper Works should be used if best results are to be obtained. For mid-range loading in power approaching that of the Springfield, various other jacketed bullets of the proper diameter can be used. Here again, however, we have the problem of various sizes of barrels due to the fact that this arm has always been of the custom-built variety in the United States; as a result, there has been no standardization of chamber dimensions. Supreme care should be taken to see that bullets of proper diameter are used. With Winchester adopting this cartridge as a standard caliber in its rifle line, it is quite likely that Du Pont and Hercules will develop more extensive loading data using standardized chambers.

.375 H. & H. Magnum

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 26-in. Barrel	Breech Pressure	Recommended by
235	English MC	.250	HiVel 2	65.0	2635[1]	49,550	JVH[2]
"	MC	"	"	66.0	2700		JBS
"	English MC	"	"	67.0	2745[1]	54,250	JVH[2]
"	MC	"	15½	70.0	2660		Du P.
"	"	"	"	20.0	1300		"
"	"	"	"	31.0	1775		"
"	"	3.50[3]	4064	57.0	2300		"
"	"	"	"	71.0	2810		"
255	MC (.38/55)	.425	17½	43.0	2030		JBS
"	"	"	SR 80	20.0	1280		Du P.
"	"	"	"	30.0	1700		"
270	MC	.400	15½	69.0	2560		"
"	"	"	"	75.0	2660[1]	52,000	JVH[2]
"	"	3.60[3]	4064	57.0	2220		Du P.
"	"	"	"	69.0	2690		"
"	"	"	SR 80	20.0	1150		"
"	"	"	"	30.0	1650		"
300	"	.450	15½	67.0	2400		"
"	"	"	SR 80	21.0	1180		"
"	"	"	"	30.0	1550		"
"	Soft Point	"	4064	56.0	2160		"
"	"	"	"	63.0	2450		"
"	"	3.60[3]	4064	56.0	2160		Du P.
"	"	"	"	63.0	2450		"
"	English MC	.450	15½	75.0	2515[1]	48,350	JVH[2]
"	"	"	16	65.0	2510[1]	55,700	"

[1] Velocity with corrosive primer.
[2] FA tests for J. V. Howe.
[3] Overall length.

.38 WCF (.38/40)

The .38/40 was one of the early successful repeating-rifle cartridges of the center-fire variety. It first was adapted to the Model 1873 Winchester, appearing late in 1874 as a companion number to the .44/40. Winchester, Marlin, Savage, Colt, and many others have manufactured repeating rifles to handle this particular cartridge. It is an excellent medium-power load, and a great many people use it for game as large as deer, although this author does not approve of the practice. With properly developed loads, it is reasonably accurate for small game and target shooting.

The handloader must bear in mind, however, that this cartridge is adapted to both rifle and handgun and must be loaded accordingly. Powder which burns well in the rifle barrel will not burn properly in the handgun barrel, and vice versa. Either jacketed or cast bullets can be used, and in the latter class the selection is unusually wide. Instead of .38 caliber, however, this cartridge is

.38/40 Winchester
(Rifle Loads)

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in. Barrel	Breech Pressure	Recommended by
130	HP	245	2400	18.0	1420	9 000	Her.
"	"	"	"	24.0	1950	17 000	"
"	"	"	"	26.0	2130	20 000	"
"	"	"	Unique	10.0	1640	10.700	"
"	"	"	"	11.9	1860	16,000	"
"	"	"	Sharpshooter	15.0	1510	9.000	"
"	"	"	"	18.0	1785	14,000	"
"	"	"	"	20.6	2020	20,000	"
"	"	"	Lightn'g	21.0	1485		"
"	"	"	"	24.0	1710	14,000	"
"	"	"	"	27.5	2000	20,000	"
"	"	.225	1204	25.0	1520		Du P.
"	"	"	"	30.5	2010		"
"	"	"	4227	31.0	2130		"
168	Lead	275	SR 80	12.5	1200		"
180	SP	.303	2400	17.0	1450	8 500	Her.
"	"	"	"	20.0	1675	13,000	"
"	"	"	"	22.6	1870	20,000	"
"	"	"	Sharpshooter	13.0	1255	9,200	"
"	"	"	"	15.4	1490	15.000	"
"	"	"	"	17.7	1690	20,000	"
"	"	"	Lightn'g	15.0	1000		"
"	"	"	"	20.0	1360	12,000	"
"	"	"	"	23.7	1620	20,000	"
"	"	.300	1204	20.0	1160		Du P.
"	"	"	"	27.5	1853		"
"	"	"	SR 80	12.5	1280		"
"	"	"	"	15.5	1400		"
"	"	"	2400	24.5	2000	27.000	JBS
"	"	"	"	25.5	2200	36,000	"
"	"	.30	4227	26.0	1850		Du P
"	Lead	.317	2400	17.0	1340	8.300	Her.
"	"	"	"	21.0	1715	14,000	"
"	"	"	"	23.6	1940	20,000	"
"	"	"	Unique	8.0	1300	10 100	"
"	"	"	"	10.2	1555	16,000	"
"	"	"	Sharpshooter	12.0	1280		"
"	"	"	"	15.0	1515	11,500	"
"	"	"	"	18.5	1800	20,000	"
"	"	"	Lightn'g	16.0	1175		"
"	"	"	"	20.0	1450	11.200	"
"	"	"	"	25.0	1780	20,000	"
"	"	.325	SR 80	14.2	1325		Du P.
"	"	"	"	18.0	1630		"

actually about .40 caliber, and since there has been more or less variation in barrel dimensions, it is well to slug your bore carefully before determining the proper bullet size. With hollow-point cast bullets it often proves to be more effective than with the jacketed soft-point or hollow-point variety. Popular for more than 60 years, this cartridge will live for a long time to come. It has always been one of the standard numbers of ammunition. This caliber can be obtained in all parts of the world.

.38/55 WINCHESTER-MARLIN AND BALLARD

The .38/55 was originally designed as a Ballard rifle cartridge. It set a great many records for accuracy which would make some of our modern match rifles blush with shame. The popularity of this big-bore cartridge grew so rapidly that Winchester and Marlin adapted it to their repeating-rifle series, and for many years it was one of the most popular deer cartridges in the United States, having far more smash than the .30/30. Today, this cartridge has lost none of its excellence from a target standpoint, and can be loaded equally well with smokeless or black powder. A wide variety of cast bullets can be obtained from various bullet-mould manufacturers, and the field is heavily dotted with excellent jacketed bullets which can be used in these rifles. For old-time rifles, however, do not exceed 25,000 pounds pressure in reloading. For the more modern type, about 35,000 can be used with reasonable safety.

.38/55 Winchester-Marlin and Ballard

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 26-in. Barrel	Breech Pressure	Recommended by
141	Lead	.250	SR 80	10.6	1140		Du P.
149	"	.263	Unique	10.0	1620	12,000	Her.
"	"	"	"	12.7	1885	22,000	"
150	"	.275	SR 80	10.0	1040		Du P.
"	"	"	GR 75	6.0	1000[1]		"
190	"	.354	2400	18.4	1760	22,000	Her.
"	"	"	Unique	10.0	1400	13,300	"
"	"	"	"	12.2	1600	22,000	"
"	"	"	Sharpshooter	15.0	1545	13,700	"
"	"	"	"	19.2	1830	22,000	"
"	"	"	Lightn'g	20.0	1495		"
"	"	"	"	24.0	1725	19,000	"
"	"	"	"	28.5	1955	28,000	"
"	"	.450	SR 80	12.0	1130[1]		PBS
"	"	"	GR 75	8.3	1100[1]		"
253	GC	.650	SR 80	21.0	1589		Du P.
255	SP	.525	3031	30.0	1555		"
"	"	"	"	35.0	1820		"
"	"	"	17½	33.3	1650		"
"	"	"	"	38.0	1825		"
"	"	"	16	29.0	1600[1]		"
"	"	"	"	32.0	1700[1]		"
"	"	"	1204	24.0	1625		"
"	"	"	18	35.0	1730[1]		"
"	"	"	"	38.0	1910[1]		"
"	"	"	SR 80	16 2	1325		"
"	"	.545	2400	15.0	1240	12,700	Her.

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 26-in. Barrel	Breech Pressure	Recommended by
255	SP	.545	2400	18.7	1505	22,000	Her.
"	"	"	Unique	9.5	1160	15,400	"
"	"	"	"	10.6	1255	22,000	"
"	"	"	Lightn'g	17.0	1180		"
"	"	"	"	21.0	1420	18,800	"
"	"	"	"	25.1	1680	28,000	"
"	"	"	Sharpshooter	13.0	1170	12,800	"
"	"	"	"	16.9	1500	22,000	"
"	"	"	HiVel 2	20.0	1070		"
"	"	"	"	26.0	1455	20,000	"
"	"	"	"	29.0	1645	28,000	"
"	"	"	HiVel 3	16.0	1060		"
"	"	"	"	21.0	1425	16,800	"
"	"	"	"	24.8	1710	28,000	"
"	Lead	.575	SR 80	16.0	1290		Du P.
"	"	.523	Unique	7.0	1090	11,400	Her.
"	"	"	"	9.9	1355	22,000	"
"	"	"	GR 75	15.0	1315[1]		Du P.
"	"	"	L Rifle	20.0			"
267	"	.700	SR 80	10.5	1030		"
279	"	.575	"	11.0	1065		"
"	"	"	"	15.5	1325		"
280	GC	.600	Unique	7.0	1042	11,100	Her.
"	"	"	"	9.9	1305	22,000	"
"	"	"	2400	14.0	1280	13,500	"
"	"	"	"	16.7	1490	22,000	"
"	"	"	Lightn'g	14.0	1060		"
"	"	"	"	18.0	1360	18,000	"
"	"	"	"	22.3	1640	28,000	"
"	"	"	Sharpshooter	12.0	1190	13,000	"
"	"	"	"	16.5	1540	22,000	"
"	"	"	HiVel 2	17.0	1010		"
"	"	"	"	23.0	1355	15,500	"
"	"	"	"	29.0	1695	28,000	"
"	"	"	HiVel 3	14.0	1025		"
"	"	"	"	20.0	1460	16,500	"
"	"	"	"	25.0	1800	28,000	"

[1] Velocity with corrosive primer.

.38/56 WCF

This cartridge was designed for the Model 1876 lever-action Winchester rifle in an effort to achieve the result of high power without increasing the length of the cartridge. As in others of that particular series, the .38/56 is a bottle-neck type of cartridge. Practically any of the .38/55 bullets can be used with reasonable success, as the majority of barrels were rifled to similar measurements. Due to the bottle-neck shell, this cartridge is readily adapted to smokeless powder reloading, but pressure should not run over 32,000 to 35,000 pounds.

.38/56 WCF

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 26-in. Barrel	Breech Pressure	Recommended by
255	SP	.525	17¼	30.2	1600		Du P.
"	"	"	Fg	56.0	1600		"
"	"	"	FFg	56.0	1600		Her.
"	"	"	1	22.0	1600		Du P.
260	MC	.500	17½	36.4	1500		"
"	"	"	"	41.6	1700		"
"	"	"	"	45.0	1840		"
"	"	"	"	46.8	1890	Max.	"
"	"	"	16	35.0	1500[1]		"
"	"	"	"	40.0	1700[1]		"
"	"	"	"	45.0	1860[1]	Max.	"

[1] Velocity with corrosive primer.

.400 WHELEN

The .400 Whelen was designed by Colonel Townsend Whelen, noted authority, while he was commanding officer of Frankford Arsenal in the early 1920's. Essentially this is the unnecked Springfield cartridge case necked but very slightly to .40 caliber. It has been widely proclaimed as an excellent cartridge by a number of our so-called authorities throughout the United States, but its designer is only lukewarm concerning its possibilities. Only a short time ago, when preparing material for this book, Colonel Whelen suggested that the author warn users of rifles in this caliber to be extremely careful in resizing their cases, and stated that he did not approve of handloading in this caliber because the very faint indication of a neck was inclined to create a serious headspace problem, if improperly resized. The cartridge is built to operate at a 50,000-pound pressure, and with overloads and excessive headspace caused by too much shortening of the neck, serious damage to the rifle and shooter can occur. Properly loaded, however, this cartridge is a very excellent killer for heavy game, at medium and long ranges up to about 400 yards. It is of course designed for use in an action of approximately the same length as the standard Springfield.

.400 Whelen

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 26-in. Barrel	Breech Pressure	Recommended by
300	MC ".405 Win."	.375	17½	60.0	2120[1]	37,000	TW
"	"	"	"	63.0	2250[1]	38,000	"
"	"	"	"	66.5	2335[1]	41,300	Du P.
"	"	"	"	67.0	2400[2]		JBS
"	"	"	16	60.0	2320[1]	42,000	TW
"	"	"	"	63.0	2370[1]	46,000	"
"	"	"	"	65.0	2515[1]	55,700[3]	JVH[4]
"	"	"	HiVel 2	57.0	2300[1]	44,000	TW
"	"	"	"	58.0	2350[1]	48,500	"
"	"	"	"	60.0	2460[1]	60,700[3]	JVH[4]
"	"	"	3031	61.0	2300		Du P.
"	"	"	SR 80	21.0	1275		"
"	"	"	"	32.0	1700		"
350	HP	.450	3031	58.0	2165		"
"	"	"	SR 80	20.0	1150		"
"	"	"	"	29.0	1500		"
"	"	"	17½	62.0	2215		"

[1] Velocity with corrosive primer.
[2] Estimated velocity.
[3] Dangerous load.
[4] FA tests for J. V. Howe.

.401 WINCHESTER SELF-LOADING

This is another of the autoloading series adapted only to Winchester rifles and is a member of the same family as the .351. It is by far the best of the Winchester autoloading numbers, however, and is an excellent cartridge for deer and other thin-skinned medium-sized game. In handloading, one must, as in other autoloading calibers, bear in mind that there can be but very little variation from the factory standard if the action is to function properly and safely.

.401 Winchester Self-Loading

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt Chg. Grs.	M V in 20-in. Barrel	Breech Pressure	Recommended by
200	SP	.217	2400	13.0	990		Her.
"	"	"	"	19.0	1595	24,500	"
"	"	"	"	24.7	2060	50,000	"
"	"	"	Unique	10.0	1290	17,800	"
"	"	"	"	15.2	1785	40,000	"
"	"	"	Sharpshooter	14.0	1150		"
"	"	"	"	19.0	1640	26,000	"
"	"	"	"	24.5	2020	50,000	"
"	"	.200	1204	26.0	1645		Du P.
"	"	"	"	30.0	1925		"
"	"	"	SR 80	12.0	1085		"
"	"	"	"	17.0	1525		"
"	"	"	4227	31.0	2100		"
250	"	.323	2400	11.0	720		Her.
"	"	"	"	18.0	1430	24 200	"
"	"	"	"	23.3	1765	50,000	"
"	"	"	Unique	9.0	1090	20 500	"
"	"	"	"	13.7	1525	40,000	"
"	"	"	Sharpshooter	11 0	860		"
"	"	"	"	16.0	1350	23,000	"
"	"	"	"	22.2	1780	50,000	"
"	"	"	Lightn'g	15.0	840		"
"	"	"	"	21.0	1350	25,000	"
"	"	"	"	30.0	1800	50,000	"
"	"	.300	1204	23.0	1415		Du P.
"	"	"	"	27.5	1740		"
"	"	"	4227	19.0	1445		"
"	"	"	"	27.5	1850		"
"	Lead	.292	2400	12.0	1050		Her.
"	"	"	"	15.0	1285	15,000	"
"	"	"	"	18.0	1480	20,100	"
"	"	"	Unique	10.0	1330	23 300	"
"	"	"	Sharpshooter	10.0	1000		"
"	"	"	"	18.0	1575	27 300	"

.404 MAGNUM

The .404 Magnum is another of those heavy cartridges of the H. & H. series which have been used somewhat in this country. It requires, for best results, a six-groove barrel with a twist of approximately 1 turn in 14 inches. This is generally known as the Jeffrey cartridge and is used in the Jeffrey Magnum Mauser rifle, chiefly for

.404 Magnum

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 26-in Barrel	Breech Pressure	Recommended by
300	MC	.475	15½	70.0	2040		Du P.
"	"	"	"	94.0	2775		"
"	"	"	17½	80 0	2550		"
"	"	"	"	92 0	2850		"
"	"	"	HiVel 2	82 0	2715[1]	47,500	JVH[2]
400	"	.575	15½	70 0	1990		Du P.
"	"	"	"	90.0	2510		"
"	"	"	17½	79 0	2350		"
"	"	"	"	88.0	[illegible]		"
"	"	"	Cordite	55.0	2035[3]	28,350	JVH[2]

[1] Velocity with corrosive primer.
[2] FA tests for J. V. Howe.
[3] English factory load tested at FA.

African hunting. It is not in wide use in this country, yet one or two of our custom ammunition loaders report that they have had a great many calls for handloaded ammunition development in this particular caliber. Owing to the capacity of the case, it does not properly lend itself to mid-range loads.

.405 WINCHESTER

The .405 Winchester cartridge is the most powerful lever-action cartridge ever built. It was designed for the Model 1895 rifle and is today still a popular number in this caliber. The cartridge is, however, a bit too powerful for anything except the heaviest of North American game. The long straight shell is reasonably easy to reload but should be carefully resized if satisfactory results are to be obtained. Also extreme attention must be paid to stretching, as in the Model 95 action it is inclined to stretch after repeated reloading.

.405 Winchester

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24-in Barrel	Breech Pressure	Recommended by
225	Lead	.220	2400	20.0	1514	10,300	Her.
"	"	"	Unique	16.0	1595	15,000	"
"	"	"	Sharpshooter	30.0	2020	20,500	"
300	SP	.384	2400	16.0	900		"
"	"	"	"	24.0	1440	17,500	"
"	"	"	"	26.0	1545	21,800	"
"	"	"	"	32.0	1840	39,000	"
"	"	"	"	34.4	1940	48,000	"
"	"	"	Unique	16.0	1325	19,000	"
"	"	"	"	22.6	1705	39,000	"
"	"	"	Sharpshooter	26.0	1620	20,000	"
"	"	"	"	34.8	2030	39,000	"
"	"	"	Lightn'g	22.0	1120		"
"	"	"	"	38.0	1800	25,200	"
"	"	"	"	46.6	2225	48,000	"
"	"	"	HiVel 2	30.0	1180		"
"	"	"	"	40.0	1695	23,300	"
"	"	"	"	53.4	2260	48,000	"
"	"	"	HiVel 3	21.0	1020		"
"	"	"	"	37.0	1850	25,000	"
"	"	"	"	46.6	2255	48,000	"
"	"	.375	3031	52.0	2040		Du P.
"	"	"	"	54.0	2120		"
"	"	"	"	57.0	2250		"
"	"	"	17½	59.0	2150		"
"	"	"	"	62.0	2250		"
"	"	"	SR 80	17.0	1140		"
"	"	"	"	26.5	1500		"
"	"	"	Her. 308	53.0	2150[1]		Her.
"	"	"	Her. 300	58.0	2200[1]	39,200	"
"	"	"	Pyro	53.0	2150[1]	43,000	"
"	"	"	16	54.2	2150[1]		Du P.
"	"	"	"	55.0	2200[1]	42,000	"
"	"	"	18	56.0	2200[1]		"
"	"	"	15	54.5	1900[1]	27,000	"
"	"	"	GR 75	20.0	1400[1]		"
"	"	"	Her. WA	59.0			Her.
"	"	"	4320	52.0	1905		Du P.
"	"	"	"	62.0	2220		"
"	Lead	.401	2400	20.0	1410	13,800	Her.
"	"	"	Unique	16.0	1460	21,000	"
"	"	"	Lightn'g	15.0	929		"
"	"	"	"	25.0	1380	11,100	"
"	"	"	HiVel 2	25.0	1140		"
"	"	"	"	40.0	1705	18,700	"
"	"	"	"	55.0	2355	48,000	"
"	"	"	HiVel 3	20.0	1090	8,200	"
"	"	"	"	25.0	1330	9,800	"

[1] Velocity with corrosive primer.

11-MM. GRAS

The 11-mm. Gras is essentially a French cartridge, although a great many of the old Remington rolling-block rifles were manufactured in this caliber. The cartridge is loaded by Remington at the present time, and that firm can supply suitable cartridge cases. It has a slight bottle neck and is not the best type for handloading, but can be so handled with reasonable success if extreme care is used.

11-mm. Gras

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 30-in. Barrel	Breech Pressure	Recommended by
385	Lead Ideal 439186		SR 80	28.0	1400		Du P.
"			"	30.0	1450		"

.44 WCF (.44/40)

This was the first cartridge developed for the Model 1873 rifle and made its appearance in that year. Within a few months the Colt factory had announced the Single-Action Army model in this caliber and was followed within a few months by other makers who built big-bore revolvers to handle it. The .44/40 makes an excellent cartridge, properly loaded, for all game up to deer, and although the author does not consider it sufficiently powerful for the latter game, it has killed thousands of deer in the United States; nevertheless, it is essentially a short-range number. It can be made to shoot reasonably accurately for target work with careful handloads, and there is a wide variety of cast and jacketed bullets available. As in others of this 1873 rifle series, one must bear in mind that loading for rifle use requires different loading data and powders from those used when the cartridge is prepared for handguns. Factory cartridges have always been a compromise. The high-velocity loadings are suitable for rifle use but actually dangerous when used in revolvers. For rifle use, do not exceed pressure of more than 33,000 pounds, and the latter figure only when guns are of recent manufacture and in perfect condition. The .44/40 is another of those cartridges which will live on to endless fame. It did its part in the establishment of the West, and the demand has continued to the point where it is doubtful if it will be retired for many years to come. The Winchester bore diameter is .429. All available soft-points are about .424. One shooter gets finest results by swaging .424 bullets to .429 for Winchester rifles. Remington and Marlin rifles meas-

ure .424, therefore factory bullets are satisfactory in these barrels. Properly loaded, this cartridge has more knockdown than a .30/30.

.44/40 Winchester
(Rifle Loads)

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 24 in. Barrel	Breech Pressure	Recommended by
140	HP	.223	2400	21.0	1600		Her.
"	"	"	"	30.0	2425	13,800	"
"	"	"	"	33.3	2730	20,000	"
"	"	"	Unique	12.0	1775	10,300	"
"	"	"	"	14.4	2035	16,000	"
"	"	"	Sharpshooter	14.0	1400		"
"	"	"	"	21.0	2040	14,000	"
"	"	"	"	24.0	2320	20,000	"
"	"	"	Lightn'g	23.0	1540		"
"	"	"	"	28.3	1870	14,000	"
"	"	"	"	30.6	2015	20,000	"
"	"	.225	1204	33.5	1900		Du P.
200	SP	.311	2400	20.0	1385	9.500	Her.
"	"	"	"	23.5	1700	14.000	"
"	"	"	"	25.4	1870	20,000	"
"	"	"	"	27.5	2100	33,000	"
"	"	"	Unique	9.0	1285	9,600	"
"	"	"	"	11.3	1520	16,000	"
"	"	"	Sharpshooter	14.0	1260		"
"	"	"	"	17.3	1305	14.000	"
"	"	"	"	19.6	1680	20,000	"
"	"	"	Lightn'g	19.0	1220		"
"	"	"	"	24.2	1555	14.000	"
"	"	"	"	26.7	1720	20.000	"
"	"	.300	1204	25.0	1400		Du P.
"	"	"	"	30.0	1830		"
"	"	"	SR 80	14.0	1300		"
"	"	"	"	18.0	1625		"
"	"	"	4227	29.0	1890		"
"	Lead	.308	2400	22.0	1530		Her.
"	"	"	"	24.0	1685	13,200	"
"	"	"	"	26.8	1910	20.000	"
"	"	"	Unique	9.0	1305	10.200	"
"	"	"	"	11.3	1530	16,000	"
"	"	"	Sharpshooter	15.0	1350		"
"	"	"	"	18.0	1580	15,200	"
"	"	"	"	20.0	1720	20,000	"
"	"	"	Lightn'g	19.0	1220		"
"	"	"	"	23.0	1465	13,500	"
"	"	"	"	26.8	1670	20,000	"
"	"	.300	SR 80	13.7	1300		Du P.

11.2 MM. KRIEGHOFF

The Krieghoff cartridge is essentially the 11.2 mm. Mauser cartridge modernized for the majority of the rifles manufactured by Heinrich Krieghoff of Suhl, Germany. A great many of these have been imported into the United States together with foreign ammunition. It is an extremely powerful big-bore rifle with a large-capacity cartridge case.

The first of these appeared in the United States in 1922 when Homer Sargent of Pasadena, California, ordered one Krieghoff. The German factory specifications indicated a muzzle velocity of 2660 f.s. with a 330-grain slug, but tests with the foreign ammunition indicated that this was closer to 2550 f.s.

Since this cartridge was first introduced here, a great many American big game hunters have been importing rifles from Krieghoff and from English manufacturers as well as from a number of other German plants. The ammunition is not made in this country, but can be obtained from Germany.

The cartridge has proved to be more popular than the .505 Gibbs and has ample power for the majority of African game. It develops about 4700 foot-pounds of muzzle energy. Components must be obtained from Germany, and it should be borne in mind that these cases are primed with Berdan primers and are therefore not reloadable. It is possible that reloaders can obtain a special Berdan primer decapping tool through the manufacturer of his rifle and order the proper German primer along with a supply of cases.

11.2 mm. Kreighoff

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 29½-in. Barrel	Breech Pressure	Recommended by
339	SP	.525	15	65.0	1860[1]		Du P.
"	"	"	15½	65.7	1880[1]		"
"	"	"	"	83.0	2310[1]		"
"	"	"	17½	70.0	2150[1]		"
"	"	"	"	75.0	2325[1]		"
"	"	"	"	80.0	2500[1]		"
"	"	"	"	82.0	2545[1]		"
"	"	"	17	77.9	2535[1]		"

[1] Velocity with corrosive primer.

.45/70

Since this was at one time a Government rifle cartridge, a great deal of handloading data has been prepared with it. Most guns will not stand over 25,000 pounds pressure safely, since the cartridge was essentially of the black powder era. The army used it only in single-shot rifles of various makes and styles and with various charges of powders and weights of bullets. The heaviest load for it was the standard .45/70/500, in which 70

.45/70

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 26-in. Barrel	Breech Pressure	Recommended by
240	Lead	.272	Unique	15.0	1648	12,300	Her.
"	"	"	"	20.8	1972	24,000	"
"	"	.250	SR 80	19.0	1115		Du P.
"	"	"	"	29.0	1630		"
300	SP	.430	2400	24.0	1560	13,500	Her.
"	"	"	"	30.6	1905	24,000	"
"	"	"	Unique	13.0	1330	12,000	"
"	"	"	"	18.7	1685	24,000	"
"	"	"	Sharpshooter	20.0	1420		"
"	"	"	"	30.0	1960	22,800	"
"	"	"	"	34.0	2125	30,000	"
"	"	"	Lightn'g	25.0	1320		"
"	"	"	"	35.0	1760	17,400	"
"	"	"	"	44.0	2125	30,000	"
"	"	"	HiVel 2	48.0	1921	26,000	"
"	"	"	Her. 300	54.0	1875	27,000	"
"	"	"	"	60.0	2050	32,000	"
"	"	.450	3031	48.0	1675		Du P.

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 26-in. Barrel	Breech Pressure	Recommended by
300	SP	.450	3031	58.0	2015		Du P.
"	"	.400	17½	51.0	1700		"
"	"	"	"	55.7	1875		"
"	"	"	"	59.0	2015		"
"	"	"	SR 80	25.0	1565		"
"	"	"	"	35.0	1800[1]		"
"	"	"	18	50.0	1800[1]		"
"	"	"	"	54.0	1925[1]		"
"	"	"	16	48.0	1780		"
"	"	"	"	50.7	1890	23,000	"
"	"	"	"	56.0	2140	32,000	"
344	Lead	.417	Unique	14.0	1335	11,700	Her.
"	"	"	"	19.2	1598	24,000	"
379	"	.450	SR 80	21.0	1115		Du P.
"	"	"	"	29.0	1450		"
405	SP	.572	2400	22.0	1290	14,000	Her.
"	"	"	"	27.4	1560	24,000	"
"	"	"	Sharpshooter	18.0	1165		"
"	"	"	"	24.0	1460	18,500	"
"	"	"	"	30.2	1730	30,000	"
"	"	"	Lightn'g	25.0	1200		"
"	"	"	"	31.0	1440	18,400	"
"	"	"	"	39.0	1760	30,000	"
"	"	"	Pyro	44.0	1500[1]	23,000	
"	"	"	"	49.0	1700[1]	32,000	
"	Lead	.535	Unique	11.0	1133	12,300	Her.
"	"	"	"	17.3	1472	24,000	"
"	"	"	Sharpshooter	20.0	1280[2]		"
"	"	.625	1204	28.5	1375		Du P.
"	"	"	"	35.0	1550		"
"	"	"	D-1 Rifle	32.0			"
"	"	"	SR 80	17.0	1050		"
500	"	.564	Unique	11.0	1020	11,600	Her.
"	"	"	"	17.2	1330	24,000	"
"	"	"	Fg Black	70.0	1320	25,000	"
"	"	"	Sharpshooter	23.2	1300	18,000	"

[1] Velocity with corrosive primer.
[2] Estimated velocity.

grains of black powder was used to drive a 500-grain pure lead bullet. Later the bullet weight was cut to 405 grains, and the smokeless jacketed bullet loading in the high-velocity type uses the 300-grain bullet. Various other weights have been tried with reasonable success. The cartridge can be handloaded to excellent accuracy with both jacketed and cast bullets. When loading for the old-timers, however, one must bear in mind that smokeless powders with jacketed bullets are extremely dangerous and destructive to the barrel.

.45/90

The .45/90 was essentially the same general type of cartridge as the .45/70, being a long, straight, rimmed case, somewhat longer than its predecessor. It was designed to give still additional power, and the original loading was with 90 grains of black powder and a lead bullet weighing 300 grains. Any of the bullets designed for the .45/70 can be used in the .45/90, and the present 300-grain soft-point factory bullet makes an excellent cartridge out of this old-timer. It is also capable of successful mid-range loading with bulk types of power of medium and coarse granulation.

.45/90

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt Chg. Grs.	M V in 26-in. Barrel	Breech Pressure	Recommended by
240	Lead	.303	Unique	16.0	1640	13,100	Her.
"	"	"	"	20.0	1860	20,000	"
300	SP	.425	2400	26.0	1440	12,500	"
"	"	"	"	31.5	1685	20,000	"
"	"	"	Unique	15.0	1370	13,000	"
"	"	"	"	19.7	1660	20,000	"
"	"	"	Lightn'g	33.0	1570		"
"	"	"	"	39.0	1795	17,000	"
"	"	"	"	45.0	2025	25,000	"
"	"	"	Sharpshooter	23.0	1420		"
"	"	"	"	29.0	1780	22,800	"
"	"	"	"	34.6	2035	30,000	"
"	"	.400	17½	54.0	1650		Du P.
"	"	"	"	60.0	1950		"
"	"	"	SR 80	27.9	1535		"
"	"	"	"	29.5	1620		"
"	"	.425	3031	64.0	2040		"
"	"	"	4198	57.0	2215		"
"	Lead	.375	80	27.4	1540		"
"	"	"	Sharpshooter	25.5	1525	12,000	Her.
344	"	.417	Unique	14.0	1285	12,200	"
"	"	"	"	18.4	1485	20,000	"
"	"	"	SR 80	25.0	1400[1]		PBS
350	"	.525	"	25.0	1430		Du P.
405	SP	.425	2400	26.0	1410	13,500	Her.
"	"	"	"	30.2	1595	20,000	"
"	"	"	Unique	14.0	1140	13,300	"
"	"	"	"	18.2	1360	20,000	"
"	"	"	Sharpshooter	18.0	1100		"
"	"	"	"	24.0	1390	15,500	"
"	"	"	"	31.0	1690	25,000	"
"	"	"	Lightn'g	26.0	1220		"
"	"	"	"	33.0	1440	15,800	"
"	"	"	"	40.8	1710	25,000	"
"	"	.550	17½	57.5	1815		Du P.
"	"	.650	3031	59.0	1890		"
"	"	"	"	60.0	1950		"
"	"	"	4198	53.0	1980		"
"	Lead	.397	Unique	17.0	1380	20,000	Her.
432	SP	.400	17½	52.0	1575[2]		Du P.
"	"	"	"	54.0	1675[2]		"

[1] Estimated velocity.
[2] Velocity with corrosive primer.

.50/70 MUSKET

Here, again, is another of the early military cartridges that preceded the .45/70. The .50/70 was loaded with various types and weights of bullets and for a wide variety of rifles. It was extremely popular in the early 1870's as a knock-down cartridge and a great many buffalo were shot with it.

.50/70 Musket

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 26-in. Barrel	Breech Pressure	Recommended by
300	Lead	.350	SR 80	25.0	1590		Du P.

.50/110 WINCHESTER

The .50/110 Winchester was designed for the Model 1886 rifle and was considerably more powerful than the old .50/70 musket. The original factory loading specified a 300-grain bullet in lead, full metal patch, soft point and hollow point. Lead

bullets in 1907 were compounded of one part tin and sixteen parts lead. This cartridge, having a straight case, is suitable for handloading, but care should be taken not to exceed the recommended factory loading.

.50/110 Winchester

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 26-in. Barrel	Breech Pressure	Recommended by
300	MC		Sharpshooter	47.0	2200[1]	Max.	Her.

[1] Velocity with corrosive primer.

505 GIBBS

The .505 Gibbs is one of the super-magnum types of rimless cartridge of extreme size, but the author can see no particular advantage in its use. The cartridge is tremendously powerful, with an excessive amount of recoil. This Gibbs cartridge has a groove diameter in properly fitting barrels of .5055 and a land diameter of .4955. The barrel has eight grooves, each .115 inch wide with the land .0795 inch wide. The twist is one turn in 16 inches. A 525-grain metal-jacketed bullet driven by 125 grains of IMR #15½ gives a muzzle velocity of 2520 f.s., and a muzzle energy of 7402 f.p. Major John W. Hessian, of Winchester, told me several years ago that he once had a wonderful session of approximately 40 consecutive rounds with this cartridge, and that he was unable to enjoy life for the following two weeks.

.505 Gibbs

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 26-in Barrel	Breech Pressure	Recommended by
525	MC	.450	15½	100.0	2000		Du P.
"	"	"	"	125.0	2520		"
"	"	.490	HiVel 2	100.0	2250[1]	28,850	JVH[2]
"	"	"	"	105.0	2390[1]	35,480	"
"	"	"	"	110.0	2455[1]	45,375	"

[1] FA tests, corrosive pri
[2] FA tests for J. V. Howe.

Identification Code—Rifle Cartridges

AHT	Allyn H. Tedmon
AJC	Allen J. Conradt
ALAH	A. L. A. Himmelwright
AW	A. L. Woodworth
B & M	Belding & Mull
BEC	Byron E. Cottrell
CAS	C. A. Shafer
CGW	C. G. Williams, Engineer Original Ross Rifle Co.
DAD Jr.	David A. Drew, Jr., Alaska
Du P.	Du Pont Burnside Laboratory
FM	Frank Mittermeier
Gebby	J. E. Gebby
GS	George Schnerring, formerly of F. A.
HAD	Harvey A. Donaldson
HGL	H. Guy Lovern
Hatcher	Julian S. Hatcher
Her.	Hercules Experiment Station
JBS	J. Bushnell Smith
JRM	James R. Mattern
JVH	James V. Howe
JWL	J. W. Landon, Pittsburgh, Pa.
Lovell	Hervey Lovell
NHR	Ned H. Roberts
OHE	O. H. Elliott
PBS	Philip B. Sharpe
R	*American Rifleman*
R in R	Roberts in *Rifleman*
Sedgley	R. F. Sedgley
Sisk	R. B. Sisk
Sweany	J. B. Sweany
TCF	Thomas C. Florich
TGS	Thomas G. Samworth
TW	Townsend Whelen
Win	Winchester
WOCE	Willis O. C. Ellis

HANDGUN LOADING TABLES

.25 ACP

This cartridge, designed for the .25 Colt Automatic pistol, for the German Mauser and a great many other automatic pistols, together with a few imported revolvers, is known in other countries as the 6.35 mm. Pistol. It does not permit of a great deal of variation in handloading. Barrels manufactured by Colt have 1 turn in 16 inches. This closely approximates that of other makes, although there is certain variation. Reloading is frequently done with cast bullets, but the metal-jacketed factory type functions much more readily through automatic pistol magazines.

.25 ACP

BULLET			POWDER		BALLISTICS		
Weigh. in Grains	Type .. Style .. Make .	Seating Depth	Kind	Wgt Chg. Grs.	M V in 2½-in. Barrel	Breech Pressure	Recommended by
50	MC	.150	5	1.4	776	15,000	Du P.
"	"	"	6	1.2	768		"
"	"	"	3	1.4	717[1]		"
"	"	"	RSQ	2.0	[1]		"
"	"	.158	Bullseye	.8	520		Her.
"	"	"	"	1.0	660	10,400	"
"	"	"	"	1.3	830	15,000	"
"	"	"	Unique	1.5	575		"
"	"	"	"	1.7	640	9,500	"
"	"	"	"	2.0	740	12 000	"
"	"	.150	SR 80	2.0	720[1]	14,500	JRM

[1] Velocity with corrosive primer.

7.63 MM. MAUSER

This cartridge is entirely different from the Luger and is intended for the .30-caliber Mauser Automatic pistol. It is a bottle-neck type of cartridge and with proper tools can be reloaded quite readily. Cartridge cases should be full-length resized, although neck sizing works fairly well in some cases. The case is manufactured by the majority of American makers, and full metal jackets, soft-point or hollow-point bullets can be obtained. The cast varieties are inclined to tie up the automatic mechanism from time to time but can be used for target work.

7.63 mm. Mauser—".30 Mauser"

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 5¼ in. Barrel	Breech Pressure	Recommended by
86	MC	.15	5	5.0	1145	26,000	Du P.
"	"	"	Bullseye	5.0	1397	29,000	Her.
"	"	"	Ballistite	7.0	1323	29,000	Hatcher

7.65 MM. LUGER

This cartridge is somewhat shorter than the Mauser Automatic pistol cartridge, although it is of a bottle-neck style. It is by no means interchangeable. The Luger cartridge is adapted to the Luger Automatic pistol and one or two foreign pistols of approximately the same design. The cartridge is short and does not readily lend itself to proper handloading unless full-length resizing is done after each firing.

7.65 mm. Luger—".30 Luger"

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 3¾-in. Barrel	Breech Pressure	Recommended by
89	Cast	.300	6	3 4	1025		Du P.
"	"	"	Bullseye	3.5	1150		Ideal
93	MC	.275	6	3.4	1065		Du P.
"	"	"	5	4 4	1170		"
"	"	"	3	4.5	1161[1]		"
"	"	"	RSQ	4.0	1150[1]		"
"	"	"	SR 80	7.0	1120		"
"	"	"	Bullseye	4.0	1173	29.000	Her.
"	"	"	Infallible	4.7	1207	29,000	Hatcher

[1] Velocity with corrosive primer.

.32 SMITH & WESSON

The .32 Smith & Wesson cartridge is a short stubby cartridge, rarely reloaded although it is a comparatively simple matter to do so. This cartridge is purely a pocket-revolver number overshadowed by the .32 S. & W. Long. It can be used in guns chambered for the Long.

.32 Smith & Wesson

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style . Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 3-in. Barrel	Breech Pressure	Recommended by
85	Fact. lead		Bullseye	1.4	725		Hatcher
88	"		"	1.4	725		"

.32 SHORT COLT

The .32 Short Colt cartridge is somewhat smaller in diameter than the .32 Smith & Wesson. Generally speaking, it does not pay to reload these small short cartridges, as the equivalent loading can be obtained in the longer cartridges with like charges of powder. The Short Colt can be used in any revolver chambered for the .32 Smith & Wesson Long or .32 Long Colt.

.32 Short Colt

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 4-in. Barrel	Breech Pressure	Recommended by
80	Fact. Lead	.125	6	1.5	800		Du P.
"	"	"	5	2.0	732		"
"	"	"	3	1 9	662[1]		"
"	"	"	RSQ	3.0	662[1]		"
"	"	"	SR 80	3.0	665		"
"	"	"	"	3.8	767		"
"	"	"	Bullseye	1.5	790		Her.
"	"	"	"	1.9	810	8,000	Hatcher
"	"	"	FFFg	7.7	820[1]	8,000	"
87	Cast	"	SS FFg	6.7	675[1]		Peters

[1] Velocity with corrosive primer.

.32 LONG COLT

The .32 Long Colt cartridge is somewhat different from the Smith & Wesson Long, although generally of the same characteristics. It is adapted to both Smith & Wesson and Colt revolvers of the old style as well as to many other more or less obsolete makes.

.32 Long Colt

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 4-in. Barrel	Breech Pressure	Recommended by
80	Fact. Lead	.125	5	2.7	835		Du P.
"	"	"	6	2.3	840		"
"	"	"	3	3.0	840[1]		"
"	"	"	RSQ	3.0	770[1]		"
"	"	"	SR 80	4.0	634		"
"	"	"	"	6.5	815		"
"	"	"	Bullseye	2.1	770	8,000	Hatcher
"	Ideal	"	5	3.1	830		Ideal
"	"	"	SR 80	6.5	815		"
"	"	"	Bulleye	2.0	765		"

[1] Velocity with corrosive primer.

.32 SMITH & WESSON LONG AND .32 COLT NEW POLICE

These two cartridges are almost identical in every way. They are therefore being grouped together. The .32 Smith & Wesson Long was born in 1895, and uses a round-nosed bullet, whereas the .32 Colt uses the same cartridge case with the typical Colt style of flat-nosed bullet. The original load called for 10.5 grains FFFg black powder. Loading data for one can readily be applied to the other, as these two cartridges are absolutely interchangeable and produce similar ballistics. The cartridge is extremely accurate for target work and can be loaded with a variety of bullets ranging from standards down through to somewhat lighter weights and wadcutting types. Peters makes a factory wadcutter load with flush-seating bullet. Don't try to duplicate this load at home.

.32 Smith & Wesson Long and .32 Colt New Police

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 4-in. Barrel	Breech Pressure	Recommended by
89	Cast	.250	6	2.0	710		Du P.
"	"	"	"	2.5	810		"
"	"	.189	Bullseye	2.0	745		Her.
"	"	"	"	1.5	696	8,000	"
"	"	"	"	2.5	880	11,000	"
"	"	"	"	3.1	1010	15,000	"
"	"	"	Unique	3.0	735		"
"	"	"	"	4.0	940	11,000	"
"	"	"	"	4.7	1065	15,000	"
"	"	"	SR 80	3.4	625		Hatcher
98	Fact. Lead	.275	5	2.6	707		Du P.
"	"	"	6	2.4	815		"
"	"	"	3	2.5	702[1]		"
"	"	"	RSQ	3 5	702[1]		"
"	"	"	SR 80	3.5	700		"
"	"	"	"	4.0	803		"
"	"	"	"	6 0	1000		"
"	"	"	"	6 5	1070		JRM
"	"	.284	Bullseye	1.5	635		Her.
"	"	"	"	2 0	770	8,800	"
"	"	"	"	2.7	910	15,000	"
"	"	"	Unique	3.0	737		"
"	"	"	"	4.0	940	12,500	"
"	"	"	"	4.3	1010	15,000	"
"	Cast	.250	6	2.0	715		Du P.
"	"	"	"	2.5	840		"
"	"	"	SS FFg[2]	9.6	790[1]		Peters
"	"	"	FFFg	13.0	790		Hatcher
100	"	.300	6	2.0	735		Du P.
"	"	"	"	2.4	830		"
"	"	"	Bullseye	2.1	745		ALAH
105	"	.250	6	2.0	710		Du P.
"	"	"	"	2.4	785		"

[1] Velocity with corrosive primer.
[2] Kings semi-smokeless powder.

.32/20 REVOLVER

The .32/20 cartridge, frequently called the .32 WCF, was essentially a rifle cartridge at the time of its birth, for the Model 1873 Winchester rifle. Shortly after it was announced, however, Colt produced the Single-Action Army Model in this cali-

.32/20 Revolver

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 7½-in. Barrel	Breech Pressure	Recommended by
47	Round Ball		Bulk Shotgun	4.0	600[1]		JRM
"	"		SSFFFg[2]	4.0			"
74	MC .32 Auto.	.162	Bullseye	2.5	840		Her
"	"	"	"	3.5	1050	11,700	"
"	"	"	"	4.0	1145	15,000	"
"	"	"	Unique	4.0	890		"
"	"	"	"	5.5	1140	11,000	"
"	"	"	"	6.6	1270	15,000	"
80	HP	.212	Bullseye	2.5	850		"
"	"	"	"	3.5	1050	11,400	"
"	"	"	"	4.2	1180	15,000	"
"	"	"	Unique	4.0	875		"
"	"	"	"	5.0	1065	10.000	"
"	"	"	"	5.9	1220	15,000	"
"	"	.200	6	3.5	945		Du P.
"	"	"	"	4.2	1090		"
"	"	"	5	4.5	985		"
"	"	"	"	6.5	1300		"
85	Cast	.225	6	3.1	880		"
"	"	"	"	3.9	1045		"
"	"	"	Bullseye	2.5	850		Her.
"	"	"	"	3.0	945	10,600	"

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 7½ in. Barrel	Breech Pressure	Recommended by
85	Cast	.225	Bullseye	3.6	1060	15,000	Her.
"	"	.213	Unique	4.0	885		"
"	"	"	"	5.0	1050	10,600	"
"	"	"	"	5.8	1160	15,000	"
90	"	.200	6	3.3	865		Du P.
"	"	"	"	4.1	1050		"
"	"	"	SR 80	6.2	700		"
"	"	"	"	8.7	1050		"
98	B & M		5	4.5	903		B & M
"	"		"	4.8	948		"
"	"		SR 80	9.5	1000		"
"	"		Bullseye	1.8	500		"
"	"		"	4.3	970		"
100	MC	272	"	2.5	740		Her.
"	"	"	"	3.0	840	11,000	"
"	"	"	"	3.6	955	15,000	"
"	"	"	Unique	3.5	720		"
"	"	"	"	4.5	900	10,200	"
"	"	"	"	5.5	1065	15,000	"
"	Fact. Lead	250	6	2.8	850		Du P.
"	"	"	"	3.6	970		"
"	"	"	5	5.0	1028		"
"	"	"	3	5.5	1013[1]		"
"	"	"	SR 80	7.4	827		"
"	"	"	"	8.6	980		"
"	Cast "Bond G"	"	6	2.8	740		"
"	"	"	"	3.6	885		"
"	Cast "Bond E"	.200	"	3.4	895		"
"	"	"	"	4.2	1035		"
"	Cast B & M	.300	"	2.7	825		"
"	"	"	"	3.5	985		"
"	"	"	5	4.4	935		"
"	"	"	"	4.9	1020		"
"	Fact. Lead	"	SS Fg[2]	16.0	954		Peters
"	Cast B & M	"	SR 80	3.5	650		B & M
"	"	"	"	9.5	995		"
"	"	"	Bullseye	1.0	500		"
"	"	"	"	1.8	600		"
"	"	"	"	4.3	970		"
103	"	.325	6	2.7	810		Du P.
"	"	"	"	3.5	925		"
"	"	"	5	4.5	930		"
"	"	"	"	4.8	970		"
111	GC	.356	Bullseye	2.0	670		Her.
"	"	"	"	2.5	790	10,500	"
"	"	"	"	3.1	910	15,000	"
"	"	"	Unique	3.5	810		"
"	"	"	"	4.0	900	11,600	"
"	"	"	"	4.6	1000	15,000	"
115	MC	.350	6	2.5	680		Du P.
"	"	"	"	3.2	805		"
"	"	"	5	4.5	770		"
"	"	"	"	5.0	870		"
"	"	.346	Bullseye	2.0	590		Her.
"	"	"	"	2.5	715	11,000	"
"	"	"	"	3.1	850	15,000	"
"	"	"	Unique	3.0	645		"
"	"	"	"	4.0	840	12,000	"
"	"	"	"	4.5	925	15,000	"
"	"	"	SR 80	7.0	755		B & M
"	B & M	.350	5	3.9	795		Du P.
"	"	"	"	4.6	910		"
"	Bond C	"	6	2.6	735		"
"	"	"	"	3.3	860		"
"	"	"	Bullseye	4.5	1042		Hatcher
"	Bond F	.325	6	2.8	755		Du P.
"	"	"	"	3.5	885		"
"	Fact. Lead	"	SR 80	9.0	985		"
"	"	"	RSQ	4.0	[1]		"
"	"	.372	Bullseye	2.0	690		Her.
"	"	"	"	2.5	800	9,000	"
"	"	"	"	3.2	930	15,000	"
"	"	"	Unique	3.0	740		"
"	"	"	"	4.0	900	8,900	"
"	"	"	"	5.1	1080	15,000	"
"	"	"	SS FFg[2]	16.5	950		Hatcher
"	"	"	Sharpshooter	9.0	954	17,000	"
120	Bond E	.325	6	2.8	750		Du P.
"	"	"	"	3.5	875		"
150	Lead	.345	Bullseye	2.0	605		Her.
"	"	"	"	2.5	695	10,000	"
"	"	"	"	3.2	800	15,000	"
"	"	"	Unique	3.0	650		"
"	"	"	"	4.0	795	10,700	"
"	"	"	"	4.7	890	15,000	"

[1] Velocity with corrosive primer.
[2] Kings semi-smokeless powder.

ber, and it was closely followed by a number of other arms makers. Today both Colt and Smith & Wesson chamber their heavy revolvers for this. Loading data on this are given in the rifle section as applicable to rifle use. For best results in handguns, pressures must be held somewhat lower and a quicker-burning type of powder used, due to the difference of barrel lengths. The .32/20 was never extremely popular for handgun use among reloaders. The cartridge is not a good one for handloading, although, with proper care and attention, reasonably accurate loads can be developed.

.32 ACP

The .32 Automatic Colt Pistol cartridge is widely used in foreign countries in various automatic pistols. It is known there as the 7.65 mm. Browning. As in all other automatic pistol cartridges, the standard velocity must be maintained if the action is to be depended upon. Cast bullets may be used if the metal is cast about 1 to 20. This cartridge can be shot in standard factory loadings in any revolver chambered for the .32 S. & W. Long cartridge. The shell is of the semi-rimmed variety rather than rimless.

.32 Automatic Colt Pistol

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 3½-in. Barrel	Breech Pressure	Recommended by
71	MC	.125	5	2.6	965		Du P.
"	"	"	3	3.0	958[1]		"
"	"	"	RSQ	3.0	[1]	Low	"
"	"	"	"	3.5	[1]		"
74	"	"	6	2.1	890		"
"	"	"	SR 80	4.0	805		"
"	"	"	"	4.5	931		"
"	"	.153	Bullseye	1.5	700		Her.
"	"	"	"	2.0	860	13,000	"
"	"	"	"	2.2	925	15,000	"
"	"	"	"	2.3	967	17,000	Hatcher
"	"	"	Unique	2.0	585		Her.
"	"	"	"	2.5	710	8,200	"
"	"	"	"	3.4	985	15,000	"
77	Cast	.200	6	2.2	965		Du P.
"	"	"	5	2.6	950		Ideal
"	"	"	Bullseye	2.2	970		Her.
"	"	"	SR 80	4.5	950		Hatcher
85	"	.210	Bullseye	1.0	565		Her.
"	"	"	"	1.5	730	11,000	"
"	"	"	"	1.8	830	15,000	"

[1] Velocity with corrosive primer.

.357 S. & W. MAGNUM

This is the most powerful revolver cartridge in the world today. It began life as a super-high-velocity .38 Special cartridge, but when the author was experimentally playing with it, he recognized the necessity of working pressures much higher than the recommended factory standards. Colonel D. B. Wesson of Smith & Wesson, in conducting experimental work in developing a gun to handle

the cartridge, bore in mind the working pressure level the author had established of 33,000 pounds, the highest pressure ever placed in any standard revolver cartridge. Numerous powders were experimented with before the most favorable combination was achieved. This also applies to bullets. Winchester, tying into the development at an early stage, adopted one of the forms of bullets designed by the author.

The cartridge case is ideal for reloading, since it has a much better-shaped combustion chamber than the average run of .38 Specials. At the same time, the brass is much stronger, designed as it is for the extremely high-pressure development, and the ignition is far superior to that of the ordinary type of revolver cartridge. As manufactured by Winchester, the primer pocket has a diameter of .210; as manufactured by the Western Cartridge Company, the diameter of the primer pocket is .175. Practically any of the .38 Special loads can be applied to this cartridge and also the entire run of .38 Special bullets. The case is somewhat longer than standard, which prevents its being chambered in .38 Special revolvers. By no means attempt to chamber a standard revolver to handle this cartridge, as serious complications will result. This statement will be disputed by the uninitiated. Nevertheless, having gone through the original development work with the manufacturer of both the gun and the cartridge, the author is more or less familiar with the problems arising and knows that the average heavy-frame revolver chambered to handle this cartridge will develop all sorts of complications after the first 150 to 200 rounds of ammunition are fired through it.

Developing the full-charge load is a major problem. Essentially the factories use a special non-canister grade of Hercules #2400, not available to handloaders. The obvious step then is Standard #2400. Charges must be weighed carefully, and if this powder is used, it must not be varied beyond the recommended charges. The powder will not work well at low pressures and is inclined to be erratic if the load is increased even slightly beyond the recommended limit. *The writer does not recommend the handloading of full charges by the average person and desires to make this clearly known.* You are loading far more power than has ever been crammed into a revolver cartridge before, and in so doing you load at your own risk. The Hercules Powder Company and Smith & Wesson refuse to recommend the reloading of this particular number because of these strings. It can be done by the careful man, however. But if care was ever needed in the reloading of a revolver cartridge, it most certainly applies to this particular number. The handloader will do much better to use these cases and load standard .38 Special charges.

.357 S. & W. Magnum

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt Chg. Grs.	M V in 8¾-in. Barrel	Breech Pressure	Recommended by
70	Lead	.164	Bullseye	4.0	1260		PBS
"	"	"	"	5.0	1500	14,000	"
"	"	"	"	6.1	1715	20,000	"
"	"	"	Unique	6.0	1360		"
"	"	"	"	8.0	1675	15,000	"
"	"	"	"	9.3	1875	20,000	"
73	Ideal 360303	.275	Bullseye	5.3	1600	17,000	"
"	"	"	Unique	8.7	1640	17,000	"
95	Lead	.157	Bullseye	2.5	870		"
"	"	"	"	4.0	1160	12,500	"
"	"	"	"	5.4	1420	20,000	"
"	"	"	Unique	6.0	1235		"
"	"	"	"	7.5	1500	14,800	"
"	"	"	"	8.9	1720	20,000	"
113	Bond D	.300	6	5.0	1220	23,000	"
"	Lead	.224	Bullseye	3.0	900		"
"	Bond D	"	"	5.0	1330	22,500	"
"	Lead	"	"	4.0	1120	14,000	"
"	"	"	Unique	6.0	1225	14,000	"
"	"	"	"	6.6	1350	16,000	"
"	"	"	Bullseye	5.1	1420	20,000	"
"	"	"	Unique	5.5	1180		"
"	"	"	"	6.5	1360	13,700	"
"	"	"	"	7.5	1570	20,000	"
115	Ideal	.278	"	4.5	1230	20,000	"
"	"	"	Bullseye	4.0	1168	15,000	"
"	"	"	Unique	5.5	1150	12,000	"
"	"	"	"	7.0	1350	22,500	"
"	Lead	.224	"	5.5	1105		"
"	"	"	"	6.5	1280	15 000	"
"	"	"	"	7.5	1425	20 000	"
"	"	"	Bullseye	3.0	900		"
"	"	"	"	4.0	1080	14 000	"
"	"	"	"	5.0	1240	20 000	"
125	Bond A	.425	6	4.2	1150	22 000	"
"	"	.325	"	4.2	1140	20,000	"
"	"	.425	5	5.8	1245	23,000	"
"	"	"	Bullseye	3.8	1180	15,000	"
"	"	.325	"	3.8	1170	13,800	"
"	"	.425	Unique	6.0	1265	17 000	"
130	B & M	.525	6	4.5	1190	22,000	"
"	"	"	5	5.5	1280	24,000	"
143	Ideal WC	.470	6	3.5	1020		"
"	"	"	5	4.5	990		"
145	Bond A	.400	"	5.5	1190	19,000	"
"	"	"	6	4.8	1215	22,000	"
"	Bond B	.300	"	4.0	1070		"
"	"	.385	Bullseye	3.6	1095	15,000	"
"	"	"	Unique	5.3	1170	16,000	"
"	Lead	.402	Bullseye	3.0	890		"
"	"	"	"	4.0	1075	16,500	"
"	"	"	"	4.5	1155	20,000	"
"	"	"	Unique	4.5	990		"
"	"	"	"	6.0	1245	15,400	"
"	"	"	"	6.8	1370	20,000	"
146	SHP	.340	5	6.0	1205	18,000	"
"	"	"	SR 80	10.0	1440	40,000	"
"	"	"	Unique	6.0	1120	13,500	"
"	"	"	"	7.5	1375	24,000	"
"	"	"	"	8.5	1520	33,000	"
"	"	"	Bullseye	5.0	1270	18,000	"
"	"	"	"	6.0	1340	33,000	"
"	"	"	6	5.0	1185	17,500	"
"	"	"	"	6.0	1350	23,000	"
"	"	"	"	6.5	1390	35,000	"
"	"	"	Red Dot	5.0	1085	17,000	"
"	"	"	"	6.0	1265	24,000	"
"	"	"	2400	12.0	1340	21,000	"
"	"	"	"	14.0	1525	29,500	"
"	"	"	"	15.0	1610	34,000	"
"	"	"	"	16.0	1655	35,000	"
"	"	.450	"	16.0	1660	36,000	"
150	Lead	.401	Bullseye	3.0	900		"
"	"	"	"	3.5	1000	14,500	"
"	"	"	"	4.1	1100	20,000	"
"	"	"	Unique	4.5	1000		"
"	"	"	"	5.5	1160	15,500	"
"	"	"	"	6.2	1265	20,000	"
"	Wadcutter	.407	Bullseye	2.5	740		"

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seat-ing Depth	Kind	Wgt. Chg. Grs.	M V in 8¾-in. Barrel	Breech Pres-sure	Recom-mended by
150	Wadcutter	407	Bullseye	3.5	960	14,500	PBS
"	"	"	"	4.2	1075	20,000	"
"	"	"	Unique	4.5	910		"
"	"	"	"	5.5	1070	16,000	"
"	"	"	"	6.2	1170	20,000	"
158	Fact. Lead	.375	6	4.5	1100	20,000	"
"	"	"	5	5.0	1070	17,000	"
"	"	"	SR 80	7.5	1000		"
"	"	"	"	10.0	1235	33,000[1]	"
"	"	"	"	11.0	1290	40,000[1]	"
"	"	"	Bullseye	4.5	1155	21,000	"
"	"	"	Unique	3.5	850	7,000	"
"	"	"	"	5.5	1150	18,500	"
"	"	"	"	6.5	1265	22,000	"
"	Fact.	.445	"	4.0	910		"
"	"	"	"	5.0	1060	13,400	"
"	"	"	"	6.0	1210	20,000	"
"	"	"	Bullseye	2.5	790		"
"	"	"	"	3.5	970	16,000	"
"	"	"	"	3.9	1035	20,000	"
160	Keith	.405	6	4.0	1025		"
"	"	"	5	5.5	1160	22,500	"
"	Sharpe	.360	6	4.0	1075		"
"	"	"	5	5.5	1185	20,000	"
"	"	"	Unique	6.5	1280	22,600	"
"	"	"	"	7.0	1315	25,000	"
"	"	"	Bullseye	4.5	1185	22,000	"
173	Lead	.439	"	2.5	760		"
"	"	"	"	3.5	930	17,600	"
"	"	"	"	3.7	965	20,000	"
"	"	"	Unique	4.5	965		"
"	"	"	"	5.5	1110	17,000	"
"	"	"	"	5.9	1165	20,000	"

[1] Dangerous, high head pressure.

.38 SMITH & WESSON
.38 COLT NEW POLICE

Here again we have a combination of two cartridges having entirely different names which are identical in every respect except the shape of the bullet. The .38 Smith & Wesson and the .38 Colt New Police revolvers use a cartridge somewhat larger in diameter than the .38 Special, and are therefore not interchangeable with the more powerful caliber. The cartridge is capable of excellent accuracy when properly reloaded and in some guns makes a very good target number. With proper-shaped bullets, it makes an admirable defense gun.

.38 S. & W. and New Police

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seat-ing Depth	Kind	Wgt. Chg. Grs.	M V in 3½-in. Barrel	Breech Pres-sure	Recom-mended by
130	Cast	.235	Bullseye	2.0	620		Her.
"	"	"	"	2.5	740	10,600	"
"	"	"	"	3.0	850	15,000	"
"	"	"	Unique	3.0	585		"
"	"	"	"	4.0	770	10,000	"
"	"	"	"	4.9	920	15,000	"
145	Fact. Lead	.250	Bullseye	2.0	580		"
"	"	"	"	2.5	695	10,300	"
"	"	"	"	3.0	800	15,000	"
"	"	"	Unique	3.0	590		"
"	"	"	"	4.0	780	10,600	"
"	"	"	"	4.7	895	15,000	"
146	Cast	"	6	2.2	640		Du P.
"	B & M Cast	"	"	2.8	760		"
"	"	"	5	3.8	796		"
"	"	"	3	3.0	580[1]		"
"	"	"	"	4.0	794[1]		"
"	"	"	RSQ	3.0	[1]		"
"	"	"	SR 80	5.9	816		"
"	"	"	"	7.0	900		"
"	"	"	SS FFg[2]	9.6	740[1]		ALAH
"	"	"	Bullseye	2.4	720[1]		B & M
147	Ideal	"	5	3.8	796		Hatcher
"	"	"	SR 80	5.9	816		"
"	"	"	Bullseye	2.0	710		"

[1] Velocity with corrosive primer.
[2] Kings semi-smokeless powder.

.38 SHORT AND LONG COLT

These two cartridges are obsolete numbers but may be used in any .38 Special gun. The Short is a long-dead outside-lubricated cartridge, while the Long is the old Army number used during the Spanish-American War. Most guns were bored oversize, but cylinders which will chamber the .38 Special and Long cases may be reloaded if care is used. It is advisable to use .38 Special cases if your gun will chamber them and load to Long specifications. The Short and Long cartridges will not produce good accuracy unless bullets are carefully fitted to the various sizes of barrels.

.38 Short Colt

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seat-ing Depth	Kind	Wgt. Chg. Grs.	M V in 6-in. Barrel	Breech Pres-sure	Recom-mended by
125	Ideal		5	2.7	700		Hatcher
150	Fact. Lead		SS FFg[1]	14.0	765		"
"	"		Bullseye	2.5	745		"

.38 Long Colt

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seat-ing Depth	Kind	Wgt. Chg. Grs.	M V in 6-in. Barrel	Breech Pres-sure	Recom-mended by
125	Bond A	.325	6	3.3	890		Du P.
"	"	"	"	4.0	1015		"
"	"	"	5	3.3	696		"
"	"	"	"	5.0	1050		"
145	"	.400	6	2.6	755		"
"	"	"	"	3.3	885		"
"	"	"	5	3.6	780		"
"	"	"	"	4.4	965		"
148	Fact. Lead	350	6	3.0	770		"
"	"	"	"	3.7	890		"
"	"	"	5	3.6	815		"
"	"	"	SR 80	6.2	795		"
"	"	"	"	7.0	881[1]		JRM
"	"	"	"	8.5	990[1]		Du P.
"	"	"	3	4.0	803[1]		"
"	"	"	RSQ	4.0	[1]		"
"	"	"	Bullseye	3.0	810[1]	12,000	Her.
"	"	"	SS FFg[2]	13.3	920[1]		Peters
150	Ideal	"	5	3.6	815		Hatcher
"	"	"	SR 80	6.2	795		"
160	Bond B	.375	5	3.2	630		Du P.
"	"	"	"	4.6	930		"
"	"	"	6	3.0	770		"
"	"	"	"	3.7	885		"

[1] Velocity with corrosive primer.
[2] Kings semi-smokeless powder.

.38 S. & W. SPECIAL AND .38 COLT SPECIAL

These two cartridges are grouped together since they are essentially the same with the exception of the shape of the bullet nose. The .38 Smith & Wesson Special cartridge is the most accurate and highly developed big-bore handgun cartridge in the world today and will shoot with a greater degree of accuracy than any other handgun cartridge with the single exception of the .22 Long Rifle. The first gun designed to handle the .38 Smith & Wesson Special was the Smith & Wesson Model 1902, round-butt Military and Police Model. This cartridge was an improvement on the official Army cartridge—the .38 Long Colt. Essentially it was an enlargement in proportion to the .32 Smith & Wesson Long, the bullet being in the same proportion as this extremely accurate smaller caliber handgun. In order to bring about this balance, it was necessary to increase the bullet weight to 158 grains, retaining the same shape as the .32 S. & W. Long.

The Army cartridge, with its somewhat lighter 148-grain bullet, used 14.4 grains of FFFg black powder, but the charge in the .38 Special was 20.6 grains of the same granulation.

The .38 Special cartridge is an extremely easy number to reload, and the entire range of killing power can be obtained by proper loading. A wider variety of bullets is available than in any other single caliber, both in factory types and in the standard lines of cast bullets.

The cartridge case has been highly developed and has gone through a number of stages of evolution from the early folded-head type through the semi-balloon type of pocket—in which the primer pocket projects into the powder cavity of the case—down to the more modern types of solid heads used by the majority of ammunition manufacturers today. It is available with two general sizes of primer; the small .175 size, and the larger .210. Cases should be carefully inspected and graded according to their make and to their style of head construction, as the semi-balloon primer pocket and the true solid-head type are inclined to give a somewhat different point of impact with some bullets and a given load. The cartridge can be loaded with round-ball load for indoor target practice and with heavy hollow-point bullets for hunting purposes. When loading round balls it is found to be practical to use a bulk type of powder and seat the round ball inside the cartridge case until it slightly compresses the powder. This gives uniform ignition. If 000 Buckshot is used for these indoor loads, bullet seating can be readily accomplished with the end of a lead pencil. Do not load maximum charges recommended below for light-frame revolvers in this caliber.

.38 Smith & Wesson Special and .38 Colt Special

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 6-in. Barrel	Breech Pressure	Recommended by
73	Ideal 360363	.175	Bullseye	3.5	1000		Her.
"	"	"	"	4.5	1220	10 000	"
"	"	"	"	5.3	1395	15,000	"
"	"	"	Unique	5.0	955		"
"	"	"	"	7.0	1260	9,500	"
"	"	"	"	8.6	1495	15,000	"
113	Bond D	.250	6	3 5	860		Du P.
"	"	"	"	4 7	1040		"
"	"	.210	Bullseye	2.0	680		Her.
"	"	"	"	3.0	870	7,000	"
"	"	"	"	4.5	1130	15,000	"
"	"	"	Unique	4.0	800		"
"	"	"	"	5.0	965	8 800	"
"	"	"	"	6.6	1215	15,000	"
115	Ideal	.250	6	3.0	835		Du P
"	"	"	"	4.4	1080		"
"	"	.278	Bullseye	2.0	640		Her.
"	"	"	"	3.0	840	9,000	"
"	"	"	"	3.8	1020	15,000	"
"	"	"	Unique	4.5	860		"
"	"	"	"	5.5	1015	11,000	"
"	"	"	"	6.3	1140	15,000	"
125	Bond A	.325	6	3.0	800		Du P.
"	"	"	"	4.2	1015		"
"	"	"	5	3.7	725		"
"	"	"	"	5.5	1080		"
"	"	"	Bullseye	1.5	550		Her.
"	"	"	"	2.5	795	7,000	"
"	"	"	"	3.7	1030	15,000	"
"	"	"	Unique	3.5	770		"
"	"	"	"	4.5	910	8 500	"
"	"	"	"	5.8	1100	15,000	"
130	B & M	.425	6	2.5	745		Du P.
"	"	"	"	4.0	1030		"
"	"	"	5	4.0	858		"
"	"	"	"	5.3	1126		"
143	Ideal Wadcutter	.375	6	2.5	710		"
"	"	"	"	3.5	885		"
"	"	"	5	3.8	700		"
"	"	"	"	4.4	840		"
145	Bond A	.400	"	4.0	800		"
"	"	"	"	4.8	925		"
"	"	"	"	5.4	1053		"
"	"	"	6	2.7	750		"
"	"	"	"	4.0	965		"
"	"	"	"	4.6	1050		PBS
"	Bond B	.300	"	3.0	770		Du P.
"	"	"	"	4 0	935		"
"	"	.387	Bullseye	1 5	550		Her.
"	"	"	"	2.5	790	9,000	"
"	"	"	"	3.5	960	15,000	"
"	"	"	Unique	3 5	730		"
"	"	"	"	4.5	905	11,000	"
"	"	"	"	5.3	1030	15,000	"
146	B & M	.425	6	2.5	715		Du P.
"	"	"	"	3.5	885		"
"	"	"	5	4.0	790		"
"	"	"	"	5.0	978		"
"	SHP	.340	"	5.8	1060	15,900	PBS
"	"	"	"	6.0	1070	16,400	"
"	"	"	SR 80	10.0	1300	37,800[1]	"
"	"	"	Unique	6.0	985	12,000	"
"	"	"	"	6.3	1025	13,600	"
"	"	"	"	6.8	1100	15,000	"
"	"	"	"	7.5	1230	22,500	"
"	"	"	"	7.7	1285	28,000	"
"	"	"	"	8.0	1315	30,800	"
"	"	"	"	8.2	1330	32,300	"
"	"	"	Bullseye	5.0	1137	17,180	"
"	"	"	"	5.5	1160	27,000	"
"	"	"	"	5.7	1185	29,400	"
"	"	"	6	5.0	1050	16,500	"
"	"	"	"	5.5	1150	19 200	"
"	"	"	"	6.0	1225	21,100	"
"	"	"	"	6.3	1255	35,000	"

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 6-in. Barrel	Breech Pressure	Recommended by
146	SHP	340	Her. Red Dot	5.0	955	16,600	PBS
"	"	"	"	6.0	1130	23,900	"
"	"	"	2400	12.0	1200	21,800	"
"	"	"	"	14.0	1380	29,700	"
"	"	.215	"	14.0	1370	29,000	"
"	"	"	"	15.0	1470	34.000	"
"	"	"	"	16.0	1511	35.000	"
"	"	.340	Unique	5.4			AJC
"	"	"	3	4.0			"
"	"	"	5	4.0			"
"	"	"	6	3.6			"
147	"	.225	"	3.0	755		Du P.
"	"	"	"	3.8	890		"
150	Ideal "Wilder"	.350	5	4.0	765		"
"	"	"	"	4.6	900		"
"	"	"	6	2.8	775		"
"	"	"	"	3.8	955		"
"	Ideal 36071-S	.300	"	3.1	760		"
"	"	"	"	4.1	915		"
"	Bond D Wadcutter	.375	"	3.0	745		"
"	"	"	"	3.7	880		"
"	Bond H	.400	"	2.9	790		"
"	"	"	"	3.7	940		"
"	Wadcutter	.390	Bullseye	2.0	635		Her.
"	"	"	"	2.5	735	9.500	"
"	"	"	"	3.3	880	15,000	"
"	"	"	Unique	3.5	720		"
"	"	"	"	4.5	890	11.500	"
"	"	"	"	5.2	995	15.000	"
"	MC	.343	Bullseye	2.0	545		"
"	"	"	"	2.5	650	9.500	"
"	"	"	"	3.3	810	15.000	"
"	"	"	Unique	3.5	665		"
"	"	"	"	4.5	820	10,500	"
"	"	"	"	5.4	950	15.000	"
152	Clark HP	"	Bullseye	5.5	1175	30,000	PBS
153	Ideal	.375	6	2.6	710		Du P.
"	"	"	"	3.6	890		"
155	"	.400	"	2.8	720		"
"	"	"	"	3.6	870		"
"	Ideal S	.325	"	2.8	745		"
"	"	"	"	3.8	915		"
158	MP	.332	Bullseye	2.0	630		Her.
"	"	"	"	2.7	775	11.500	"
"	"	"	"	3.2	865	15,000	"
"	"	"	Unique	3.5	650		"
"	"	"	"	4.5	855	11,500	"
"	"	"	"	5.1	960	15,000	"
"	Fact. Lead	.350	6	2.7	665		Du P.
"	"	"	"	4.2	930		"
"	"	"	5	3.5	650		"
"	"	"	"	5.0	920	17,500	"
"	"	"	SR 80	7.4	860[3]		"
"	"	"	"	8.0	892[3]		"
"	"	"	"	10.0	1100	31,000	PBS
"	"	"	"	11.0	1150[3]	38,000	Du P.
"	"	"	3	5.0	895		"
"	"	"	RSQ	3.5	[1]		"
"	"	"	"	4.5	[1]		"
"	"	"	"	5.0	870[3]		"
"	"	.273	Bullseye	1.5	515		Her.
"	"	"	"	2.5	730	8,000	"
"	"	"	"	3.5	910	15,000	"
"	"	"	"	4.0	954	17,700	PBS
"	"	"	"	4.3	1010	20,000	"
"	"	"	Unique	3.5	720	7,100	"
"	"	"	"	4.5	870	11,200	Her.
"	"	"	"	5.4	1000	15,000	"
"	"	"	"	5.5	1010	17,000	PBS
"	"	"	"	6.0	1076	18,500	"
"	"	"	"	6.4	1125	19,000	"
"	"	"	"	6.6	1130	20,900	"
"	Ideal	350	6	2.6	700		Du P.
"	"	"	"	3.6	885		"
"	"	"	5	5.0	950		Hatcher
"	"	"	Bullseye	3.0	790		"
"	"	"	SS FFg[2]	18.0	820		"
160	Keith	.375	6	2.9	735		Du P.
"	"	"	"	3.7	875		"
"	"	"	5	5.3	1000	20,000	PBS
"	B & M	.400	6	3.0	785		Du P.
"	"	"	"	3.8	910		"
"	Bond D	"	"	2.9	785		"
"	"	"	"	3.6	895		"
"	B & M	"	5	4.2	851		"
"	"	"	"	5.2	1018		"
"	Bond B	.375	6	2.9	740		"
"	"	"	"	3.6	870		"
164	Bond F	500	"	2.6	775		"
"	"	"	"	3.3	875		"
164	Bond F	.505	Bullseye	2.0	660		Her.
"	"	"	"	2.5	750	11,200	"
"	"	"	"	3.0	850	15,000	"
"	"	"	Unique	2.5	590		"
"	"	"	"	3.5	765	8,800	"
"	"	"	"	4.5	930	15,000	"
165	B & M	.525	5	3.2	706		Du P.
"	"	"	"	4.2	925		"
"	"	"	6	2.6	775		"
"	"	"	"	3.6	970		"
173	Ideal	.375	"	3.0	745		"
"	"	"	"	3.6	840		"
"	"	.347	Bullseye	2.0	600		Her.
"	"	"	"	2.5	690	9,000	"
"	"	"	"	3.3	820	15,000	"
"	"	"	Unique	3.0	630		"
"	"	"	"	4.0	780	9,500	"
"	"	"	"	5.0	925	15,000	"
200	Fact. Lead	.433	Bullseye	1.5	480		"
"	"	"	"	2.0	590	10,500	"
"	"	"	"	2.7	720	15,000	"
"	"	"	Unique	2.0	450		"
"	"	"	"	3.0	640	10,000	"
"	"	"	"	4.1	810	15.000	"
"	"	"	Infallible	4.0	671	15.000	Hatcher

[1] Dangerous. [2] Kings semi-smokeless powder.
[3] Velocity with corrosive primer.

.38 ACP

The .38 Automatic Colt Pistol, the first practical automatic pistol, was placed on the market in the

.38 Automatic

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 5-in. Barrel	Breech Pressure	Recommended by
107	Cast	.160	Bullseye	3.0	880		Her.
"	"	"	"	3.5	980	15.000	"
"	"	"	"	5.7	1360	35.000	"
"	"	"	Unique	4.5	860		"
"	"	"	"	5.5	1035	15.000	"
"	"	"	"	8.4	1480	35,000	"
125	Ideal	.250	5	5.0	1100		Ideal
"	"	"	6	4.4	1040		Du P.
"	"	.246	Bullseye	2.5	755		Her.
"	"	"	"	3.0	850	15 000	"
"	"	"	"	4.0	1100	30,000	Hatcher
"	"	"	"	4.7	1145	35,000	Her.
"	"	"	Unique	4.0	820		"
"	"	"	"	4.6	915	15,000	"
"	"	"	"	7.0	1270	35,000	"
130	MC	.211	Bullseye	2.5	690		"
"	"	"	"	2.9	780	15,000	"
"	"	"	"	4.6	1200	28.000	Hatcher
"	"	"	"	5.0	1275	35,000	Her.
"	"	"	Unique	4.0	755		"
"	"	"	"	4.7	880	15,000	"
"	"	"	"	7.7	1310	35,000	"
"	"	.200	SR 80	8.5	1107		Du P.
"	"	"	5	5.6	1135		"
"	"	"	3	5.0	1068[1]		"
"	"	"	6	4.6	1080		"
"	"	"	RSQ	4.0	[1]		"
"	"	"	"	6.0	[1]		"
"	HP	.224	Bullseye	2.5	690		Her.
"	"	"	"	3.0	805	15,000	"
"	"	"	"	5.3	1225	35.000	"
"	"	"	Unique	4.0	770		"
"	"	"	"	4.7	890	15,000	"
"	"	"	"	7.6	1330	35,000	"
"	Cast	.232	Bullseye	2.5	760		"
"	"	"	"	3.1	890	15,000	"
"	"	"	"	5.0	1180	35,000	"
"	"	"	Unique	4.0	810		"
"	"	"	"	4.9	965	15,000	"
"	"	"	"	7.5	1340	35,000	"
"	"	.250	6	4.7	1110		Du P.
158	.38 Special	.275	5	4.0	880		"
"	"	"	6	3.8	945		"
"	"	"	SR 80	6.0	875		B & M
"	"	"	"	6.6	975		"

[1] Velocity with corrosive primer.

late 1890's by Colt. It was produced first as a Military and later as a pocket model, having the grip or handle at right angles with the barrel and slide. There were no safeties on either of these two models. In recent years, the Colt company produced a .38 Super automatic pistol by converting their standard .45 Government Model into a .38 caliber. The cartridge is of the semi-rimmed variety and of a bore corresponding with the .38 Special. A wide variety of bullets can be used. If the cartridge is, however, to be used in an automatic arm, metal-jacketed bullets should be used; and if cast bullets are to be experimented with, they should be of the round-nosed variety and not softer than 1 part tin to 20 parts lead, otherwise they will mutilate and cause jams. This cartridge is not intended to be crimped heavily on the bullet, and accordingly cast bullets will not stand a great deal of battering.

.380 ACP

The .380 Automatic Pistol Cartridge was designed by Browning for use in the Colt Automatic Pistol and is widely used in a great many foreign automatics available in this country as well as in the Remington, Savage, and other now obsolete automatic pistols. In Europe it is known as the 9 mm. Browning Short to differentiate it from the regular .38 Automatic pistol cartridge known there as the 9 mm. Browning Long. The cartridge is of the true rimless variety and is a medium-power load.

.380 Automatic

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 3¾ in. Barrel	Breech Pressure	Recommended by
95	MC	.150	5	3.1	910		Du P.
"	"	"	SR 80	5.0	790		"
"	"	"	"	6.0	915		"
"	"	.157	Bullseye	2.0	690		Her.
"	"	"	"	2.5	830	11,800	"
"	"	"	"	2.9	930	15,000	"
"	"	"	Unique	3.0	650		"
"	"	"	"	4.0	855	11,100	"
"	"	"	"	4.8	1010	15,000	"
107	Cast	.160	Bullseye	1.5	570		"
"	"	"	"	2.0	710	8,500	"
"	"	"	"	2.7	895	15,000	"
"	"	"	Unique	3.0	690		"
"	"	"	"	4.0	885	12,300	"
"	"	"	"	4.5	970	15,000	"

9 MM. LUGER

The 9 mm. Luger is an automatic pistol cartridge far superior to the .30 Luger or 7.65 mm., as it is frequently called. The 9 mm. is approximately .35 caliber and the majority of .35 caliber or .38 Special bullets can be used experimentally, although the action does not permit of a great deal of flexibility. This caliber is far better for reloading purposes than the smaller caliber number of the line, as it is a straight-shell rather than a bottle-neck variety. The body of the shell is the same diameter as the .30 caliber, and the action will handle either type. An interchangeable barrel and receiver will make two calibers of guns out of the same action. Working pressure of the 9 mm. is around 30,000 pounds to the square inch. Light loads usually fail to operate the mechanism but can be used with excellent success as a single shot.

9 mm. Luger

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt Chg. Grs.	M V in 4-in. Barrel	Breech Pressure	Recommended by
112	Bond E	.250	6	2.6	865		Du P.
"	"	"	"	3.6	1060		"
"	"	.175	5	4.0	865		"
"	"	"	"	5.0	1080		"
124	MC	"	"	4.0	875		"
"	"	"	"	4.6	975		"
"	"	"	6	3.0	840		"
"	"	"	"	4.0	1025		"
"	"	"	Bullseye	4.8			JRM
127	Ideal	.250	6	2.4	830		Du P.
"	"	"	"	3.4	1010		"
"	"	"	5	6.0	1135		Hatcher
"	"	"	Bullseye	4.8	1120		"
134	MC	.200	5	5.1	1105		Du P.

.38/40 REVOLVER (38 WCF)

Actually this revolver is approximately .40 caliber, and was developed by Colt in the single-action line in 1875 to accommodate the then growing popularity of the .38/40 cartridge in the old Model 1873 Winchester lever-action rifle. Since this is a rifle cartridge, loading data for rifle use are in-

.38/40 Revolver

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt Chg. Grs.	M V in 5½-in. Barrel	Breech Pressure	Recommended by
96	Round Ball		Bullseye	3.0			ALAH
130	MC	.225	5	8.0	1000		Du P.
"	"	"	"	11.0	1310		"
"	"	.350	6	7.0	1060		"
"	"	"	"	8.0	1140		"
"	"	.245	Bullseye	5.5	930		Her.
"	"	"	"	6.5	1000	11,200	"
"	"	"	"	7.4	1175	15,000	"
"	"	"	Unique	8.0	935		"
"	"	"	"	10.0	1130	10,000	"
"	"	"	"	12.0	1320	15,000	"
168	Bond A	.250	5	8.8	980		Du P.
"	"	"	"	10.6	1175		"
"	"	"	6	6.8	1015		"
"	"	"	"	7.8	1105		"
180	Fact. Lead	.325	"	6.0	800		"
"	"	"	"	7.0	945		"
"	"	"	5	8.0	950		"
"	"	"	3	9.3	1004[1]		"
"	"	"	RSQ	5.5	[1]		"
"	"	"	SR 80	11.0	700[1]		"
"	"	"	"	14.8	1030[1]		"
"	"	"	"	17.0	1200[1]	Max.	"
"	"	"	SS FFg[1]	33.0	850		Hatcher
"	"	.317	Bul.seye	4.0	735		Her.

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 5½-in. Barrel	Breech Pressure	Recommended by
180	Fact. Lead	.317	Bullseye	5.0	860	10,500	Her.
"	"	"	"	5.9	960	15,000	"
"	"	"	Unique	7.0	825		"
"	"	"	"	8.5	970	10,500	"
"	"	"	"	10.0	1105	15,000	"
"	"	"	Sharpshooter	16.0	950	14,000	Hatcher
"	Bond A	.350	5	8.0	943		Du P.
"	"	"	"	10.0	1140		"
"	"	"	6	6.0	925		"
"	"	"	"	7.0	1050		"
"	SP[1]	.303	Bullseye	4.5	750		Her.
"	"	"	"	5.5	865	11,000	"
"	"	"	"	6.5	970	15,000	"
"	"	"	Unique	6.0	720		"
"	"	"	"	8.0	930	10,700	"
"	"	"	"	9.2	1040	15,000	"
185	B & M	.325	6	6.0	940		Du P.
"	"	"	"	7.0	1025		"
"	"	"	5	7.5	871		"
"	"	"	"	8.5	1006		"

[1] Velocity with corrosive primer.
[2] Kings semi-smokeless powder.

cluded in the rifle section of these tabulations. Different powders are, of course, required for the shorter barrels of revolvers. Being slightly bottlenecked, the cartridge loads with comparative ease, but extreme care should be taken in resizing of shells. These shells are not built as strongly as some of the others in the handgun group, since the cartridge, although obsolete, insists on hanging on to popularity with the shooter. After more than 60 years of service, it is still a big seller in the handgun line.

.41 SHORT COLT

The .41 Short Colt is a now obsolete centerfire cartridge used in a great many of the earlier revolvers as well as the standard Colt line. It is not a good cartridge for reloading. The majority of guns available today to handle the Short will also handle the .41 Long Colt. The latter case should be used for handloading wherever possible.

.41 Short Colt

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 6-in. Barrel	Breech Pressure	Recommended by
160	Fact. Lead		Bullseye	2.4	625	10,000	Her.
"	"		"	2.7	672	12,000	Hatcher
"	"		5	4.0	725		Du P.
"	"		SS FFg[1]	14.0	710		Peters
"	"		"	15.0			Hatcher

[1] Kings semi-smokeless powder.

.41 LONG COLT

The .41 Long Colt is a better version of .41 caliber revolver cartridge than the Short. It has an extremely blunt semi-round-nosed bullet, the most effective shape of the standard factory revolver loads, from the killing standpoint. This cartridge is growing in popularity among police officers, particularly with handloads, which offer far better performance than any factory load could give.

.41 Long Colt

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 6-in. Barrel	Breech Pressure	Recommended by
195	Fact. Lead	.425	5	4.3	727		Du P.
"	"	"	3	4.4	727[1]		"
"	"	"	RSQ	4.0	[1]		"
"	"	"	SR 80	7.0	737[1]		"
"	"	"	"	9.5	953[1]		"
"	"	"	Bullseye	3.3	715[1]		Her.
"	"	"	"	3.5	750	14,000	Hatcher
196	Ideal	"	Pistol 5	4.2	730		"
"	"	"	Bullseye	3.0	700		"
"	"	"	SS Fg[2]	25.0	710		"

[1] Velocity with corrosive primer.
[2] Kings semi-smokeless powder.

.44 SMITH & WESSON AMERICAN

This is now an obsolete cartridge which was designed for the old .44 Smith & Wesson American Revolver used about 1872. It was essentially an outside-lubricated black-powder cartridge and has been improved but very slightly during recent years. Except for the old revolvers, the .44 Russian and the .44 Special are far superior. It should be loaded lightly, although any of the .44 Russian or .44 Special bullets will work in this case. Do not endeavor to increase maximum recommended loads, as this was designed for guns which do not compare with modern numbers from the standpoint of strength of material.

.44 S. & W. American

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 6-in. Barrel	Breech Pressure	Recommended by
218	Fact. Lead		FFg Black	25.0	650		Hatcher
200	Ideal		SR 80	12.0	800		"
"	"		5	6.0	800		"
"	"		SS FFg[1]	20.0	650		"

[1] Kings semi-smokeless powder.

.44 COLT

The .44 Colt cartridge is somewhat similar to the .44 Special in size although but slightly shorter. It is now an obsolete cartridge rarely found. It was designed for the old Colt .44 Army Revolver. The .44 Colt is a black-powder cartridge, and as cartridge cases have not been made for years, they are not of current quality. Reloading should be cautious.

.44 Colt

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 6-in. Barrel	Breech Pressure	Recommended by
210	Fact. Lead		FFg Black	2.5	660		Hatcher

.44 BULLDOG

This is an English cartridge which was popular at one time in the United States through a great many imported big-bore pocket revolvers. The major arms and ammunition companies manufactured this cartridge at the turn of the century. Today it is rarely found. The cartridge case is short and stubby and not at all satisfactory for handloading purposes. It was, of course, designed solely for black powder and only light loads of smokeless can be used with reasonable success.

.44 Bulldog

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 4½-in. Barrel	Breech Pressure	Recommended by
170	Fact. Lead		FFg Black	15.0	460		Hatcher

.44 WEBLEY

This is another English cartridge in the big-bore handgun field of more or less pocket style, which was popular in the United States at the turn of the century and was made by most of our American ammunition manufacturers. It is now rarely found. The cartridge case is short, similar to the .44 Bulldog, and is none too easy to reload. Such cases as may be available are usually of very thin construction and not capable of standing up under smokeless powder loads.

.44 Webley

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 4½-in. Barrel	Breech Pressure	Recommended by
200	Fact. Lead		FFg Black	18.0	560		Hatcher

.44 SMITH & WESSON RUSSIAN

The .44 Russian cartridge was designed for the Smith & Wesson Russian-model single-action breakdown revolver. Since its introduction in the 1870's as a somewhat more powerful version of the old .44 American, this cartridge has become exceedingly popular. In the latter part of the last century it was considered *the* standard big-bore target cartridge. In the old Smith & Wesson target arms as well as the old Colt Bisley Model Single Action, this cartridge set a great many records. It is an excellent number for reloading, and since it is of the same caliber as the .44 Special, any of the bullets adapted to that cartridge can be used with equal success in the Russian. Any of the standard handgun powders will work in this cartridge, including Du Pont Pistol #5 and #6, Sporting Rifle #80, and Hercules Bullseye and Unique.

.44 Russian

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 4-in. Barrel	Breech Pressure	Recommended by
119	Lead Ball		Bullseye	2.8			ALAH
175	Ideal	.250	6	5.0	785		Du P.
"	"	"	"	5.9	915		"
"	"	.300	"	4.5	755		"
"	"	"	"	5.3	855		"
"	"	.250	5	5.0	725		Ideal
"	"	"	Bullseye	3.0			ALAH
205	"	.300	6	5.0	785		Du P.
"	"	"	5	5.4	700		Ideal
"	"	"	Bullseye	3.0			JRM
246	Fact. Lead	.350	6	4.4	685		Du P.
"	"	"	5	5.6	720		"
"	"	"	"	6.9	830		"
"	"	"	3	5.6	720[1]		"
"	"	"	RSQ	4.0	[1]		"
"	"	"	"	5.5	[1]		"
"	"	"	"	6.0	[1]		"
"	"	"	Bullseye	5.5	680		Her.
"	"	"	SR 80	8.0	695[1]		Du P.
"	"	"	"	9.6	837[1]		"
"	"	"	"	12.0	1010[1]	Max.	"
"	"	"	FFg Black	23.0	750[1]		Hatcher
"	Ideal	.375	6	4.1	655		Du P.
"	"	"	5	5.6	720		Hatcher
"	"	"	Bullseye	5.5	674		"
"	"	"	SS FFg[2]	19.0	700		"
253	"	.356	6	4.2	645		Du P.
"	"	"	5	5.4	680		Ideal

[1] Velocity with corrosive primer.
[2] Kings semi-smokeless powder.

.44 S. & W. SPECIAL

The .44 Smith & Wesson Special cartridge is probably the most desirable of the entire run of big-bore handgun cartridges, particularly from the standpoint of the reloader. It is somewhat longer than the .44 S. & W. Russian and is capable of the finest accuracy possible in any caliber above .38. The cartridge case was particularly designed for target shooting and for proper combustion of powder. It was originally a black-powder cartridge, but it seems to perform about as well with smokeless powder as one might desire. A wide range of bullets is available in this caliber, and a great many shooters who like to play with the .44 Special and the .44/40 make a practice of having a spare cylinder to enable them to change from one to the other. The barrels measure identically

.44 S. & W. Special

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt Chg. Grs.	M V in 6½-in. Barrel	Breech Pressure	Recommended by
145	Bond B 429580	.180	Bullseye	5.5	955		Her.
"	"	"	"	6.5	1100	10,600	"
"	"	"	"	7.5	1230	15,000	"
"	"	"	Unique	9.0	1035		"
"	"	"	"	10.5	1225	11,000	"
"	"	"	"	11.7	1350	15,000	"
"	Bond B 429565	200	6	7.0	920		"
"	"	"	"	8.0	1005		"
173	Idea. 429348	.300	"	6.0	775		Du P.
"	"	"	"	6.8	880		"
"	"	.273	Bullseye	5.0	850		Her.
"	"	"	"	6.0	960	11,600	"
"	"	"	"	6.8	1055	15,000	"
"	"	"	Unique	8.0	900		"
"	"	"	"	9.0	1025	11,200	"
"	"	"	"	10.3	1170	15,000	"
"	"	.262	"	12.4	1400	22.000	JWL.
175	Ideal 429220	.270	Bullseye	6.5	1005	15,000	Her.
189	Clark H.P	285	6	7.8	1170	25,900	PBS
192	B & M 429200	.400	SR 80	9.5	865		Du P.
"	"	"	"	10.5	960		"
"	"	"	5	6.0	858		"
"	"	"	"	7.0	980		"
"	"	"	6	5.2	875		"
"	"	"	"	6.0	965		"
200	Cast HP	.250	5	7.2	875		"
"	"	.293	Bullseye	4.5	810		Her.
"	"	"	"	5.5	910	11,400	"
"	"	"	"	6.5	1010	15,000	"
"	"	"	Unique	7.0	845		"
"	"	"	"	8.5	1005	10,900	"
"	"	"	"	9.9	1135	15,000	"
202	B & M 429205	.350	SR 80	12.0	890		Du P.
"	"	"	"	13.0	985		"
"	"	.400	6	5.5	875		"
"	"	"	"	6.5	980		"
"	"	.350	5	6.5	869		"
"	"	"	"	8.0	1048		"
"	"	.269	2400	21.1	1360	23,100	JWL.
205	Ideal 429215	.293	Bullseye	3.0	630		Her.
"	"	"	"	4.5	810	8,400	"
"	"	"	"	5.9	975	15,000	"
"	"	"	Unique	7.0	820		"
"	"	"	"	8.5	1015	11 000	"
"	"	"	"	9.7	1135	15,000	"
"	"	"	SR 80	13.5	900		Du P.
215	Bond B 429750	.350	5	5.0	625		"
"	"	"	"	7.5	940		"
"	"	"	6	5.0	810		"
"	"	"	"	6.0	915		"
"	"	.368	Bullseye	4.0	710		Her.
"	"	"	"	5.0	840	11,000	"
"	"	"	"	5.7	925	15,000	"
"	"	"	Unique	6.0	750		"
"	"	"	"	7.5	920	10 000	"
"	"	"	"	9.0	1070	15.000	"
227	Ideal 429422	.400	6	5.0	750		"
"	"	"	"	6.5	910		"
235	B & M 429240	.425	"	4.8	765		Du P.
"	"	"	"	6.3	940		"
"	"	"	SR 80	9.5	770		"
"	"	"	"	10.5	925		"
"	"	"	5	5.8	767		"
"	"	"	"	7.2	941		"
"	"	.346	Bullseye	3.0	628		Her.
"	"	"	"	4.5	790	10,900	"
"	"	"	"	5.3	875	15,000	"
"	"	"	Unique	5.0	710		"
"	"	"	"	7.0	895	11,500	"
"	"	"	"	8.1	1005	15,000	"
236	B & M 429260	.550	SR 80	7.0	687		Du P.
"	"	"	"	8.5	855		"
"	"	"	"	9.0	925		"
240	Bond A 429750	.400	6	5.2	775		"
"	"	"	"	6.2	885		"
"	"	"	5	6.0	725		"
"	"	"	"	7.0	850		"
242	SHP	.375	"	6.5	780	11,000	PBS
"	"	"	"	7.7	905	17,500	"
"	"	"	6	5.5	765	11,440	"
"	"	"	"	6.7	875	18,360	"
"	"	"	Unique	7.5	840	11,120	"
"	"	"	"	8.8	950	18,180	"
"	"	.307	2400	18.0	1070	15,000	"
"	"	"	"	20.0	1200	19,700	"
244	Ideal 429383	.350	6	5.0	755		Du P.
"	"	"	"	5.8	850		"
244	Ideal 429383	.377	Bullseye	3.0	540		Her.
"	"	"	"	3.5	605	7,200	"
"	"	"	"	5.1	810	15,000	"
"	"	"	Unique	5.0	650		"
"	"	"	"	6.5	810	10,700	"
"	"	"	"	7.8	930	15,000	"
"	"	"	"	9.7	1100	22,000	JWL.
245	Ideal 429352	.350	6	5.0	740		Du P.
"	"	"	"	5.6	785		"
"	"	"	5	7.0	900		Hatcher
"	"	"	Bullseye	6.3	740		"
"	"	"	SS FFg[1]	22.5	730		"
246	Bond C 429655	.375	6	5.0	710		Du P.
"	"	"	"	5.8	790		"
"	Fact. Lead	"	"	5.1	770		"
"	"	"	"	5.9	850		"
"	"	"	5	6.0	751		"
"	"	"	"	7.5	950		"
"	"	"	SR 80	8.0	656		"
"	"	"	"	9.5	800		"
"	"	"	"	11.0	906		"
"	"	"	3	6.2	755[2]		"
"	"	"	"	6.8	850[2]		"
"	"	"	RSQ	5.0	1		"
"	"	"	"	6.0	1		"
"	"	"	"	7.5	1		"
"	"	.393	Bullseye	3.0	635		Her.
"	"	"	"	4.5	760	9,400	"
"	"	"	"	5.6	885	15,000	"
"	"	"	"	6.5	950	16,800	PBS
"	"	"	2400	18.0	1080	13 500	"
"	"	"	"	18.4	1100	15,000	"
"	"	"	Unique	6.0	735		Her.
"	"	"	"	7.5	900	10,400	"
"	"	"	"	9.0	1035	15,000	"
"	"	"	FFg Black	26.0	780		Hatcher
"	MC	.325	Bullseye	4.0	620		Her.
"	"	"	"	5.0	735	13,000	"
"	"	"	"	5.5	795	15,000	"
"	"	"	Unique	5.0	635		"
"	"	"	"	7.0	815	11,000	"
"	"	"	"	8.3	935	15,000	"
250	Ideal 429336	.375	5	6.0	610		Du P.
"	"	"	"	7.0	800		"
"	"	"	SR 80	9.0	605		"
"	"	"	"	11.0	750		"
"	"	"	6	5.1	750		"
"	"	"	"	6.1	850		"
"	Ideal 429421	.350	"	5.0	720		"
"	"	"	"	5.6	785		"
"	"	.335	Bullseye	2.0	480		Her.
"	"	"	"	3.0	590	6,300	"
"	"	"	"	4.9	805	15,000	"
"	"	"	Unique	5.5	660		"
"	"	"	"	6.5	810	8,800	"
"	"	"	"	7.9	960	15,000	"
"	Flat Pt. Sq. Shoulder	.374	Bullseye	3.5	640		"
"	"	"	"	4.5	750	10,600	"
"	"	"	"	5.4	850	15,000	"
"	"	"	Unique	6.5	755		"
"	"	"	"	7.5	900	12.000	"
"	"	"	"	8.5	985	15,000	"
253	Ideal 429251	.350	6	5.0	715		Du P.
"	"	"	"	6.0	810		"
255	B & M 429260	.575	"	5.0	836		"
"	"	"	"	5.7	920		"
260	Sharpe	.375	5	6.3	760	11.000	PBS
"	"	"	"	7.5	875	17,700	"
"	"	"	6	5.1	725	11,380	"
"	"	"	"	6.4	840	18,080	"

[1] Kings semi-smokeless powder.
[2] Velocity with corrosive primer.

the same, and therefore bullets adapted to one caliber can be readily used in the other. This is not true, of course, of powder charges. Watch your loading carefully.

Of the group of big bores, there is perhaps the widest variety of handloads available in this caliber, due to the fact that it has been so highly specialized over a long period of years. The tabulation below lists more than 160 different loads. In

addition, there are many dozens of bullets which are not included in the following data, chiefly because tested ballistic data are not available. The cartridge was designed for smokeless powder loading not exceeding 15,000 pounds, and it is well to heed this level. Cartridge cases are of the semi-balloon type of construction; the primer pocket projects into the powder cavity of the cartridge case. This type of construction does not create the extreme strength possible with the modern solid-head form as exemplified in automatic pistol cartridges and in the current run of .38 Specials. Cases should be resized at frequent intervals, although one may get as many as eight or ten normal loads out of a single cartridge case before it swells to the point of sticking in the chambers. Under ordinary circumstances, two or three reloadings without full-length resizing will create this problem. A single cartridge case sticking in the chamber creates no serious extraction problem, but when all six chambers are so filled, it is extremely difficult to withdraw the fired shells.

.44/40 REVOLVER (.44 WCF)

In 1873 when Winchester announced the famous lever-action rifle for the .44/40 cartridge, the Colt boys almost immediately followed suit with an announcement that their Single-Action Army Model 1873 would be made available to handle this cartridge. The primary excuse for this was the elimination of two different sizes of cartridges for rifle and revolver, thus reducing the amount of ammunition the user would be forced to carry with him. It immediately found favor, and after more than 60 years of continuous service, it is today one of our extremely popular big-bore handgun cartridges. The .44/40 is capable of excellent performance when loaded properly for handgun use. If, however, one endeavors to combine loading for both handgun and rifle in this caliber, he is destined to meet with only mediocre success. As in all other dual-purpose cartridges, the factory loads are only a compromise at best. Smokeless-powder loading for handguns requires a much more rapid-burning type than loading for rifle use, as the short barrel must burn all the powder if satisfactory results are to be achieved. In addition, rifle cartridges can be loaded to a pressure of about 30,000 pounds in this caliber, whereas the same load in a revolver would be more or less disastrous. A wide range of bullets is available. Since there are a great many diameters of barrels in this caliber, however, the handloader should ascertain the necessary bullet size by slugging his bore and measuring the slug carefully.

.44/40 Revolver

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 5½-in. Barrel	Breech Pressure	Recommended by
140	MC	.200	6	9.0	925		Du P.
"	"	"	"	10.5	1095		"
"	"	"	5	9.0	875		"
"	"	"	"	11.0	1115		"
"	"	.223	Bullseye	6.0	960		Her.
"	"	"	"	8.0	1130	10,600	"
"	"	"	"	9.3	1255	15,000	"
"	"	"	Unique	10.0	1030		"
"	"	"	"	12.0	1205	10,400	"
"	"	"	"	14.1	1400	15,000	"
175	Cast	.232	Bullseye	4.0	710		"
"	"	"	"	6.0	900	8,500	"
"	"	"	"	8.2	1110	15,000	"
"	"	"	Unique	6.0	700		"
"	"	"	"	9.0	950	8,500	"
"	"	"	"	11.9	1200	15,000	"
190	Bond A	.325	6	7.0	900		Du P.
"	"	"	"	8.0	1000		"
"	"	.287	Bullseye	5.0	790		Her.
"	"	"	"	6.0	885	10,600	"
"	"	"	"	7.0	980	15,000	"
"	"	"	Unique	8.0	835		"
"	"	"	"	10.0	1020	10,600	"
"	"	"	"	11.3	1130	15,000	"
195	B & M	.250	5	9.2	790		Du P.
"	"	"	"	11.5	945		"
"	"	"	SR 80	19.0	920		Hatcher
200	Fact. Lead	.325	6	7.0	770		Du P.
"	"	"	"	8.0	945		"
"	"	"	5	9.2	925		"
"	"	"	"	11.5	1150		"
"	"	"	3	8.8	925[1]		"
"	"	"	SS FFg[2]	32.0	930		Hatcher
"	"	"	RSQ	6.0	800[1]		Du P.
"	"	"	Sharpshooter	16.8	905	15 000	Hatcher
"	Bond B	.400	6	6.6	845		Du P.
"	"	"	"	7.4	915		"
"	"	.310	Unique	11.1	1110	15.000	JBS
"	"	"	2400	22.5			"
"	"	.325	SR 80	15.3	918[1]		Du P.
"	"	"	"	16.0	928[1]		"
"	"	"	"	19.0	1120[1]		"
"	"	"	SS Fg	31.3	920[1]		Peters
"	SP	.311	Bullseye	5.0	780		Her.
"	"	"	"	6.0	880	11,400	"
"	"	"	"	6.7	955	15,000	"
"	"	"	Unique	7.0	640		"
"	"	"	"	8.0	815	7,200	"
"	"	"	"	11.1	1100	15,000	"
205	Cast	.277	Bullseye	4.0	685		"
"	"	"	"	5.0	780	10,000	"
"	"	"	"	6.6	935	15,000	"
"	"	"	Unique	6.0	740		"
"	"	"	"	8.0	885	9,000	"
"	"	"	"	10.9	1100	15,000	"
210	Ideal	.300	6	6.6	840		Du P.
"	"	"	"	7.2	880		"
244	Cast	.320	Bullseye	4.0	630		Her.
"	"	"	"	5.0	720	10 500	"
"	"	"	"	6.4	845	15,000	"
"	"	"	Unique	5.0	620		"
"	"	"	"	7.0	760	9,100	"
"	"	"	"	9.3	935	15.000	"
250	Ideal	.357	Bullseye	3.0	545		"
"	"	"	"	4.5	690	8 000	"
"	"	"	"	6.5	890	15,000	"
"	"	"	Unique	5.0	620		"
"	"	"	"	7.0	780	9.000	"
"	"	"	"	9.4	965	15,000	"

[1] Velocity with corrosive primer
[2] Kings semi-smokeless powder.

.45 SMITH & WESSON

The .45 Smith & Wesson is now an obsolete cartridge. It was the forerunner of the .45 Colt. It was designed in the early 1870's and widely used by the Army in breakdown-model revolvers before

the Single-Action Colt was officially adopted in 1873. The majority of the original Single-Action Colts were also designed to handle the .45 Smith & Wesson cartridge. Essentially this is the same as the .45 Colt with a slightly shorter case. It is now an obsolete specimen and very little loading information is available.

.45 S. & W.

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 6-in. Barrel	Breech Pressure	Recommended by
230	Fact. Lead		FFg Black	28.0	735		Hatcher
250	"		"	28.0	710		"

.45 COLT

The .45 Colt Revolver cartridge has always been one of the most popular handgun cartridges ever manufactured, particularly with men who desire the stopping quality of big-caliber guns. The .45 Colt was born with the single action back in 1873. It has been loaded with a number of different black powder loadings and with several standards of bullet weights. Today black powder loadings can be obtained as well as a variety of smokeless powder forms. It is a very excellent cartridge for reloading, although not as satisfactory as the .44 Special. This is another cartridge which has made American history and will live for many years to come, despite more than 60 years of continuous service.

.45 Colt

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type Style Make	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 5½-in. Barrel	Breech Pressure	Recommended by
145	Round Ball		Bullseye	3.0			ALAH
184	Bond B	.250	5	7.0	785		Du P.
"	"	"	"	10.5	1140		"
"	Bond A	"	SR 80	14.0	1000[1,2]		JRM
190	Bond B	.350	6	7.0	945		Du P.
"	"	"	"	8.0	1030		"
"	"	"	5	7.0	845		"
"	"	"	"	8.5	1015		"
"	"	.337	Bullseye	5.0	785		Her.
"	"	"	"	6.0	900	8,500	"
"	"	"	"	7.8	1090	15,000	"
"	"	"	Unique	9.0	925		"
"	"	"	"	10.3	1055	12,000	"
"	"	"	"	11.8	1165	15,000	"
192	Bond A	.250	6	8.2	1050		Du P.
"	"	"	"	9.5	1120		"
"	"	"	Bullseye	5.0	780		Her.
"	"	"	"	6.5	950	10,500	"
"	"	"	"	7.9	1085	15,000	"
"	"	"	Unique	9.0	950		"
"	"	"	"	10.5	1080	11,500	"
"	"	"	"	12.1	1205	15,000	"
200	Cas.	"	5	9.2	925		Du P.
"	"	"	"	10.5	1050		"
205	B & M	.275	"	8.0	701		"
"	"	"	"	10.0	968		"
"	"	"	6	6.8	900		"
"	"	"	"	7.8	1000		"
234	FMJ		RSQ	6.9	750		Gov. Exper.
235	Bond C	.450	6	6.3	785		Du P.
"	"	"	"	7.2	915		"
"	"	.444	Bullseye	5.0	780		Her.
"	"	"	"	6.0	880	12,000	"
"	"	"	"	6.8	950	15,000	"
"	"	"	Unique	8.0	860		"
"	"	"	"	9.0	930	11,200	"
"	"	"	"	10.7	1050	15,000	"
240	B & M	.350	5	7.5	770		Du P.
"	"	"	"	9.5	942		"
"	"	"	6	6.1	820		"
"	"	"	"	7.1	925		"
243	Bond	"	"	6.2	820		"
"	"	"	"	7.2	915		"
"	"	"	5	6.5	685		"
"	"	"	"	9.0	990		"
250	Fact. Lead	.375	6	6.7	840		"
"	"	"	"	7.7	915		"
"	"	"	5	7.2	825		"
"	"	"	"	8.5	925		"
"	"	"	3	7.0	776[1]		"
"	"	"	"	8.5	900[1]		"
"	"	"	RSQ	7.0	760[1]		"
"	"	"	SR 80	12.0	792[1]		"
"	"	"	"	15.0	925[1]		"
"	"	"	FFg Black	40.0	910[1]		Hatcher
"	Ideal	.300	6	7.0	840		Du P.
"	"	"	"	7.7	900		"
"	Fact. Lead	.285	Bullseye	5.0	760		Her.
"	"	"	"	6.0	850	12,500	"
"	"	"	"	6.6	900	15,000	"
"	"	"	Unique	8.0	850		"
"	"	"	"	9.0	930	11,600	"
"	"	"	"	10.3	1030	15,000	"
255	Ideal	.425	[illegible]	8.0	870		Hatcher
"	"	"	SR 80	12.0	785		"
"	"	"	6	5.5	750		Du P.
"	"	"	"	7.0	855		"
"	B & M	.300	"	5.8	750		"
"	"	"	"	6.7	825		"
"	Bond A	.500	"	5.8	815		"
"	"	"	"	6.8	905		"
"	Bond B	.525	"	5.2	755		"
"	"	"	"	6.1	840		"
"	"	.352	Bullseye	6.0	870	12,000	Her.
"	"	"	"	6.9	945	15,000	"
"	"	"	Unique	9.0	940	11,500	"
"	"	"	"	10.4	1045	15,000	"
"	Bond D	.350	6	5.5	745		Du P.
"	"	"	"	6.5	855		"
"	Bond E	"	"	6.0	790		"
"	"	"	"	6.8	870		"
"	Fact. Lead	"	RSQ	8.4	738		US Gov Load
"	"	.502	Bullseye	4.0	675		Her.
"	"	"	"	5.0	785	11,000	"
"	"	"	"	6.0	880	15,000	"
"	"	"	Unique	6.0	680		"
"	"	"	"	7.0	780	9,000	"
"	"	"	"	8.9	960	15,000	"
"	Fact. Lead	.500	SS Fg[3]	28.9	790		Peters
"	"	"	FFg Black	40.0	900		Hatcher
"	"	"	"	34.0	800		"
258	Bond F	.300	6	5.8	720		Du P.
"	"	"	"	7.3	855		"
"	"	.356	Bullseye	5.0	725		Her.
"	"	"	"	6.0	810	11,500	"
"	"	"	"	7.0	895	15,000	"
"	"	"	Unique	8.0	800		"
"	"	"	"	9.0	890	11,700	"
"	"	"	"	10.3	990	15,000	"
260	Bond A	.500	5	6.0	675		Du P.
"	"	"	"	7.5	845		"

[1] Velocity with corrosive primer.
[2] Estimated velocity.
[3] Kings semi-smokeless powder.

.45 ACP
.45 AUTO RIM

The .45 Automatic Pistol cartridge is the standard cartridge for side arms of the United States Army. It is also used widely for police purposes in the Thompson sub-machine gun. This cartridge

was born around 1905 or slightly earlier, when John M. Browning decided to increase the caliber of the .38 Military Automatic Pistol. Accordingly he designed a .45 Automatic pistol known as the Colt Model 1905, for many years obsolete and now extremely rare. The original cartridge was identical with the present variety but had a 200-grain bullet at a velocity of about 900 f.s. The original automatic pistol was designed without any form of safety; one submitted to the United States Army for adoption was rejected partially because of this, and Mr. Browning was instructed to redesign the gun and build it to handle a cartridge with a somewhat heavier jacketed bullet. The 230-grain automatic pistol bullet was designed at Frankford Arsenal and used experimentally in revolvers.

The eventual development of an automatic pistol became known as a Colt Government Model 1911, and at this time the Model 1905 .45 Auto was abandoned. The 200-grain bullet was continued as a high-velocity load in addition to the standard 230-grain at a muzzle velocity of about 800 f.s. In the middle 1920's the various ammunition manufacturers gradually abandoned the 200-grain bullet, so that today the only commercial load used for this is the 230-grain. The Automatic does not lend itself to very flexible handloading, and overloads are inclined to give more or less trouble with the action. The .45 Automatic Pistol cartridge, however, is one of the easiest to handload of the entire series. The cartridge case is straight with no taper. It is of rimless construction and its head dimensions are almost identical with those of the .30/06 Rifle cartridge. For proper operation, shells must always be full-length resized, and this resizing should always be done by forcing the case through a sizing die, base first if possible. If cast bullets are to be used in the automatic pistol, they must be of an alloy not softer than 1 part tin to 15 lead, if best results are to be obtained.

A special note on this cartridge is that it must not be crimped when used in the automatic pistol. The mouth of the cartridge case seats against the forward shoulder of the chamber and acts as a stop. If any crimp is applied, this shoulder location is changed more or less, thus dangerously increasing headspace. This may or may not be disastrous to a gun but is inclined to give more or less misfires or hangfires, particularly since the blow of the firing pin first tends to drive the cartridge deeper into the chamber before discharging the primer.

The Automatic pistol cartridge, however, was also used widely in revolvers during the World War. The Model 1917 revolver, manufactured by both Colt and Smith & Wesson for the Army,

.45 Auto and Auto Rim

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 5-in. Barrel	Breech Pressure	Recommended by
145	Round Ball	.232	Bullseye	4.0	865		Her.
"	"	"	"	5.0	987	12,700	"
"	"	"	"	5.5	1010	15,000	"
"	"	"	Unique	6.0	855		"
"	"	"	"	7.0	960	10,300	"
"	"	"	"	8.5	1070	15,000	"
162	Bond D	.300	6	4.5	855		Du P.
"	"	"	"	5.5	1065		"
192	Cast	.250	Bullseye	3.0	695		Her
"	"	"	"	4.0	840	11,700	"
"	"	"	"	4.6	930	15,000	"
"	"	"	Unique	5.5	820		"
"	"	"	"	6.5	910	12,500	"
"	"	"	"	7.1	975	15,000	"
200	MC	.225	6	3.5	665		Du P.
"	"	"	"	5.5	950		"
"	"	"	5	6.6	905		"
"	"	"	3	6.0	827[1]		"
"	"	"	RSQ	8.0	[1]		"
"	"	"	SR 80	10.5	900[1]		"
"	"	.224	Bullseye	3.5	635		Her.
"	"	"	"	4.5	790	11,500	"
"	"	"	"	5.2	885	15,000	"
"	"	"	Unique	5.5	665		"
"	"	"	"	7.0	835	11,300	"
"	"	"	"	8.1	960	15,000	"
703	B & M	.275	6	4.1	840		Du P
"	"	"	"	5.1	970		"
"	"	"	5	5.0	850[2]		JRM
"	"	"	"	6.6	930[2]		"
"	"	"	Bullseye	3.5			"
"	"	"	"	4.7	870[2]		"
"	"	"	SR 80	8.5	770[2]		B & M
220	Ideal	.250	6	3.8	760		Du P.
"	"	"	"	4.8	885		"
"	"	"	5	4.2	680		"
"	"	"	"	5.6	880		"
"	Fact. Lead	.300	"	3.8	605		"
"	"	"	"	5.3	850		"
"	Bond C	"	6	3.8	755		"
"	"	"	"	4.8	900		"
230	MC	"	5	4.0	565		"
"	"	"	"	5.4	800		"
"	"	"	"	6.1	825		Hatcher
"	"	"	6	3.2	620		Du P.
"	"	"	"	4.7	870		"
"	"	"	"	5.1	870		"
"	"	"	SR 80	8.6	807		"
"	"	"	3	6.0	800		"
"	"	"	RSQ				"
"	"	.290	Bullseye	3.0	530		Her.
"	"	"	"	4.0	690	11,200	"
"	"	"	"	4.8	810	14,000	"
"	"	"	"	4.9	821	15,000	Hatcher
"	"	"	Unique	5.0	555		Her.
"	"	"	"	6.5	760	11,200	"
"	"	"	"	7.5	880	15,000	"
"	Fact. Lead	.300	5	5.5	850		Du P.
"	"	.214	Bullseye	3.0	640		Her.
"	"	"	"	4.0	777	11,000	"
"	"	"	"	4.7	870	15,000	"
"	"	"	Unique	5.5	765		"
"	"	"	"	6.5	875	12,000	"
"	"	"	"	7.2	940	15,000	"
"	Ideal	.300	6	3.7	755		Du P.
"	"	"	"	4.7	880		"
"	Bond B	.350	"	3.5	730		"
"	"	"	"	5.0	930		"
"	Bond A	.275	"	4.0	740		"
"	"	"	"	5.0	872		"
235	B & M	.325	5	4.0	634		"
"	"	"	"	5.1	803		"
"	"	.350	6	3.7	760		"
"	"	"	"	4.7	885		"
"	"	"	Bullseye	4.0	800[2]		B & M
"	"	"	SR 80	6.0	610		"
"	"	"	"	7.5	755		"
236	"	.325	6	3.9	785		Du P.
"	"	"	"	4.9	905		"
"	"	"	5	4.0	596		"
"	"	"	"	4.9	757		"
"	"	"	SR 80	6.0	605		B & M
"	"	"	"	7.5	775		"
"	"	"	Bullseye	4.0	800		"
"	"	"	"	4.4	850		"
240	Ideal	.350	6	3.6	735		Du P.
"	"	"	"	4.6	860		"
"	"	.294	Bullseye	3.0	650		Her.
"	"	"	"	4.0	785	12,000	"
"	"	"	"	4.5	845	15,000	"
"	"	"	Unique	5.0	695		"

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 5-in. Barrel	Breech Pressure	Recommended by
240	Ideal	.294	Unique	6.0	800	10,600	Her.
"	"	"	"	7.0	905	15,000	"
250	MC	.290	Bullseye	3.0	520		"
"	"	"	"	4.0	670	12,000	"
"	"	"	"	4.5	745	15,000	"
"	"	"	Unique	5.0	580		"
"	"	"	"	6.0	710	11,000	"
"	"	"	"	7.2	845	15,000	"
255	Fact. Lead	.342	Bullseye	3.0	640		"
"	"	"	"	4.0	780	12,500	"
"	"	"	"	4.5	840	15,000	"
"	"	"	Unique	5.0	730		"
"	"	"	"	6.0	840	12,400	"
"	"	"	"	6.6	905	15,000	"
258	Cast Wadcutter	.356	Bullseye	2.5	580		"
"	"	"	"	3.5	720	10,200	"
"	"	"	"	4.2	800	15,000	"
"	"	"	Unique	4.5	640		"
"	"	"	"	5.5	765	11,500	"
"	"	"	"	6.2	850	15,000	"

[1] Velocity with corrosive primer.
[2] Estimated velocity.

was essentially a standard .44 Smith & Wesson Military and a .45 Colt New Service with special cylinders to handle the automatic pistol cartridge in a pair of clips, each holding three of the rimless shells. Colt produced for the Army 151,700 Model 1917's, and Smith & Wesson turned out 153,311, up to December 31, 1918, commencing at the start of the American entry into the war. The Model 1917 revolver is still manufactured by Smith & Wesson and can be obtained by members of the NRA as a used gun from the Army through the office of the Director of Civilian Marksmanship.

When the pistol cartridge is loaded for use in revolvers, a much wider range of flexibility is permitted. The very light load, medium and full-charge numbers, with a wide assortment of cast bullets, may be used. The majority of the standard .45 revolver bullets can be used, but the short case more or less limits the seating depths of these bullets. When used in revolvers with a lead bullet, the case, of course, should be crimped to hold the bullet in place, for the recoil of the gun is inclined to move it outward, spilling the powder into the mechanism and otherwise tying up the shooting.

The .45 Auto Rim cartridge was a cartridge first produced by the Peters Cartridge Company around 1922 to eliminate the necessity of using clips in shooting the Model 1917 revolver. This particular cartridge is of the rimmed variety, but the rim is unusually thick, having the combined thickness of a normal pistol cartridge rim plus the thickness of the former clip. This cartridge case is of the solid-head type of construction and is an excellent number for reloading. In resizing it, the rim makes it necessary to size in conventional manner. Metal-jacketed bullets can be used for reloading with the Auto Rim cartridge as well as with the rimless pistol form.

.450 REVOLVER

The .450 Revolver was another black-powder, short, stubby cartridge designed for the solid-frame low-priced "bulldog" type of pocket guns used during the early part of the century. The case is somewhat smaller than the .45 Colt and will rattle around loosely in a standard .45 chamber. It is a poor cartridge for reloading, and guns of this type are generally not sufficiently accurate to make handloading worth while.

.450 Revolver

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 6-in. Barrel	Breech Pressure	Recommended by
220	Fact. Lead		Fine Black	13.0	590		Hatcher

.455 COLT

The .455 Colt cartridge is the official Canadian Service cartridge. It has a somewhat longer case than the .455 Webley Mark II used by the British Government, but guns chambered for the .455 Colt will also handle the .455 Webley with excellent results. The bullet is a long conical-nosed type with a large hollow base intended to permit of easy upset. This bullet is identical with the Webley Mark II type. The power of the Colt is somewhat greater than the English loading, and the size of the case makes it better adapted to handloading. Any of the standard .45 bullets can be used in a .455 barrel, as handguns made by both Colt and Smith & Wesson for the Canadian and British Governments were almost identical with our own .45-caliber barrels.

.455 Long Colt

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 5½-in. Barrel	Breech Pressure	Recommended by
198	Bond B	.350	5	5.0	635		Du P.
"	"	"	"	6.0	785		"
265	"	.325	"	5.0	590		"
"	"	"	"	6.0	730		"
"	"	"	Bullseye	3.8	700[1]		Her.

[1] Estimated velocity.

.455 WEBLEY MARK II

This cartridge is known in England commercially as a .455 Cordite, since the British Govern-

ment loading employs finely cut cordite powder. The cartridge case has an unusually thin rim, which makes it somewhat delicate to handle in resizing dies, but it is being successfully handloaded by a great many shooters.

This cartridge as factory-loaded by Remington and by the British and Canadian Governments, uses a lead bullet, long and semi-pointed, somewhat undersize, and with a deep conical cavity in the base to permit of easy upset. It is none too accurate when so loaded, and handloaders should stick to cast bullets properly fitting the barrel and with flat bases.

The case was designed for use with smokeless powder and with any of the modern pistol powders will give very satisfactory performance. In case capacity it compares quite favorably with the .45 Auto and .45 Autorim, but is by no means as satisfactory for reloading because of the thin rim and semi-balloon type of primer pocket. The head is weak, and shells will have a short life. Due to the thin brass, low pressures should be used and the case full-length resized each time it is fired.

.455 Webley Mk.II

BULLET			POWDER		BALLISTICS		
Weight in Grains	Type .. Style .. Make ..	Seating Depth	Kind	Wgt. Chg. Grs.	M V in 5½-in. Barrel	Breech Pressure	Recommended by
198	Bond B	.325	6	3.1	655		Du P.
"	"	"	"	4.1	845		"
"	"	"	5	4.2	725		"
"	"	"	SR 80	8.0	655		"
"	"	"	"	9.5	808[1]		"
235	B & M	.350	6	3.2	670		"
"	"	"	"	3.8	775		"
"	"	"	5	3.5	610		"
"	"	"	"	4.5	775		"
265	Fact. Lead	"	"	4.2	675		"
"	"	.400	6	3.7	720		"
"	"	.350	SR 80	8.5	585		"
"	"	"	"	10.0	710[1]		"
290	Ideal	"	6	3.6	665		"

[1] Velocity with corrosive primer.

Identification Code—Handgun Cartridges

S. Sol .. ..Sharpe Solid
SHP . ...Sharpe Hollow-point
FACT. ....Standard Factory Bullet
AJC .. .. .Allen J. Conradt, Hamburg, N. Y.
ALAH . ... A. L. A. Himmelwright
JRM .... . J. R. Mattern
Hatcher .... Col. J. S. Hatcher in his 1935 edition of *Pistols and Revolvers.*
JBS . .. . J. Bushnell Smith of Smith's Custom Loads
PBS . ... Philip B. Sharpe
B & M . Belding & Mull Handbook
Ideal .. .. ..Ideal Handbook

For other identifications see codes on rifle loads.

PART THREE

APPENDIX

APPENDIX

THE SMOKELESS POWDER SITUATION

When the first and second editions of this treatise on handloading were published, we included in this section, the complete list of Hercules and Du Pont powder magazines with lists of distributors scattered throughout the country. Naturally there have been many changes, and experience indicates that there will be future changes. As a result, we believe it to be of more value to the handloader to know where he may obtain information regarding his nearest source of powders. Most powders are retailed at a standard price by dealers. If you cannot find what you are seeking at your sporting goods store—which will save express charges—it is suggested that you write the nearest sales office which will advise you of the name and address of your nearest dealer maintaining a stock.

HERCULES POWDER COMPANY

Sales Offices

Birmingham 1, Alabama,
17 N. 20th St.

Chicago 4, Ill.,
McCormick Bldg., 332 S. Michigan Ave.

Duluth 2, Minn.,
314 West Superior St.

Hazleton, Pa.,
8 West Broad St.

Joplin, Mo.,
404 Main St.

New York 18, N.Y.,
500 Fifth Ave.

Pittsburgh 22, Pa.,
301 Fifth Ave.

Salt Lake City 1, Utah,
136 S. Main St.

San Francisco 4, Calif.,
256 Montgomery St.

Address inquiries to "Hercules Powder Company" at any of the addresses given above, or to their main office, Wilmington 99, Del.

E. I. DU PONT DE NEMOURS & COMPANY

Branch Offices

Birmingham 2, Ala.,
601 Brown-Marx Bldg., 2000 First Ave.

Chicago 4, Ill.,
1814 McCormick Bldg., 332 S. Michigan Ave.

Denver 2, Colo.,
Midland Savings Bldg., 444 17th St.

Duluth 2, Minn.,
Hartley Bldg., 742 E. Superior St.

Huntington 1, W. Va.,
West Va. Bldg., 4th Ave. & 9th St.

Joplin, Mo.,
Joplin National Bank Bldg., 402 Main St.

New York 1, N.Y.,
Empire State Bldg., 350 Fifth Ave.

Pittsburgh 19, Pa.
915 Gulf Bldg., 7th Ave. & Grant St.

Pottsville, Pa.,
Schuylkill Trust Bldg., Centre & Market Sts.

San Francisco 4, Calif.,
111 Sutter St.

Scranton 2, Pa.,
703 First National Bank Bldg., 207 Wyoming.

Seattle 4, Wash.,
1108 Hoge Bldg., 701 Second Ave.

Spokane 8, Wash.,
721 Old National Bank Bldg., Riverside & Stevens.

Wilkes-Barre, Pa.,
902 Brooks Bldg., 15 S. Franklin St.

BALLISTIC SPECIFICATIONS FOR CENTERFIRE RIFLE CARTRIDGES

There is more or less confusion concerning printed ballistics giving specifications of centerfire rifle cartridges as loaded by the various commercial manufacturers. Shortly before this volume went to press the Sporting Arms and Ammunition Manufacturers' Institute, an organization composed of all makers of sporting firearms, assembled together a group of the ballistics engineers connected with each member of the Institute Very definite specifications were established with suitable translation figures for determining muzzle velocity in the various calibers.

The Institute determined definitely the average loadings for instrumental velocity which would be accepted as standard. Data on pressures are not quoted here since pressures vary tremendously with different lots of ammunition and the Institute merely indicates the maximum individual permitted pressure and the average pressure. Hence these data are omitted.

The important facts covering bullet weights and velocities, both instrumental and at 100 yards, length of barrel in which these figures are achieved is given herewith. They are the accepted standard at press time but like all other standards are of course subject to change without notice.

CARTRIDGE	BULLET WEIGHT	INST. VELOCITY IN F.S. AT 78 FT. ± 25 F.S.	MUZZLE VEL. IN F.S.	REMAINING VEL. AT 100 YDS. IN F.S.	BARREL LENGTH
6 mm. U. S. N.	112	2460	2530	2250	30
6.5 mm. Mann. Improved	145	2300	2360	2110	18
6.5 mm. Mann.-Schoenauer	123	2375	2450	2160	18
6.5 mm. Mann.-Schoenauer	129	2300	2370	2090	18
6.5 mm. Mann.-Schoenauer	150	2200	2260	2030	18
6.5 mm. Mann.-Schoenauer	160	2110	2160	1950	18
7 mm. Mauser	139	2820	2880	2660	30
7 mm. Mauser	175	2400	2460	2220	30
7.62 mm. Russian	148	2840	2900	2650	30
7.62 mm. Russian	150	2750	2810	2570	30
7.65 mm. Mauser	154	2820	2880	2640	30
7.65 mm. Mauser	215	2000	2050	1840	30
7 65 mm. Peruvian	180	2625	2700	2410	30
8 mm. (7.9 mm.) Mauser Spl.	170	2450	2530	2240	29.5
8 mm. (7.9 mm.) Mauser Spl.	170	2450	2530	2240	29.5
8 mm. (7.9 mm.) Mauser	154	2820	2890	2640	29.5
8 mm. (7.9 mm.) Mauser & Mann.	227	2050	2110	1890	29 5
8 mm. (7 9 mm.) Mauser & Mann.	236	2050	2100	1890	29.5
8 mm. Mann.-Schoenauer	200	2100	2150	1940	22
8 mm. Lebel	170	2530	2610	2320	31.5
8 mm. Lebel	198	2300	2370	2100	31.5
9 mm. Mauser & Mann.	275	2000*	2060	1840	24
9 mm. Mauser & Mann.	280	2000*	2060	1840	24
.218	46	2660	2860	2220	24
.219 Zipper	46	3210	3390	2740	26

CARTRIDGE	BULLET WEIGHT	INST. VELOCITY IN F.S. AT 78 FT. ± 25 F.S.	MUZZLE VEL. IN F.S.	REMAINING VEL. AT 100 YDS. IN F.S.	BARREL LENGTH
.219 Zipper	56	2915	3050	2530	26
.22 Hornet	45	2350	2500	1940	24
.22 Hornet Hi-Speed	45	2500	2650	2090	24
.22 Hornet Hi-Speed	45	2500	2630	2120	24
.22 Hornet Hi-Speed	45	2500	2600	2210	24
.22 Savage Hi-Power	70	2700	2810	2400	22
.22 Savage Hi-Power	70	2700	2780	2480	22
.22 W. C. F. Single-Shot	45	1340*	1410	1090	26
.220 Swift	46	3940†	4140	3370	26
.220 Swift	48	3940†	4140	3490	26
.220 Swift	56	3540	3690	3090	26
.25 Remington	117	2225	2300	2020	22
.25 Remington Hi-Speed	87	2600	2710	2300	22
.25 Remington Improved	100	2370	2460	2120	22
.25/20 W. C. F.	86	1400*	1450	1190	24
.25/20 W. C. F.	86	1400*	1450	1190	24
.25/20 W. C. F. Hi-Velocity	86	1650*	1710	1380	24
.25/20 W. C. F. Super Speed	60	2075	2170	1670	24
.25/20 W. C. F. Single-Shot	86	1335*	1380	1150	28
.25/20 Stevens Single-Shot	86	1335*	1380	1150	28
.25/35 W. C. F.	117	2200	2280	1970	26
.25/35 W. C. F. Improved	100	2385	2480	2100	26
.25/35 W. C. F. Hi-Speed	87	2550	2650	1980	26
.25/36 Marlin	117	1860*	1900	1650	26
.250/3000 Savage	87	2925	3000	2710	24
.250/3000 Savage Express	100	2725	2810	2480	24
.256 Newton	129	2700	2770	2500	24
.257 Remington-Roberts	87	3100	3220	2760	24
.257 Remington-Roberts	100	2800	2900	2580	24
.257 Remington-Roberts	117	2550	2630	2330	24
.270 W. C. F.	100	3450	3540	3210	24
.270 W. C. F.	130	3060	3140	2830	24
.270 W. C. F.	130	3060	3120	2880	24
.270 W. C. F.	150	2700	2770	2490	24
.275 H. & H. Magnum	175	2500	2560	2320	26
.280 Ross	150	2750	2880	2590	31
.280 Ross	145	2840	2920	2590	31
.30 W. C. F.	110	2600	2720	2260	26
.30 W. C. F.	125	2455	2560	2160	26
.30 W. C. F.	150	2300	2380	2060	26
.30 W. C. F.	160	2125	2200	1910	26
.30 W. C. F.	165	2125	2200	1920	26
.30 W. C. F.	170	2125	2200	1920	26
.30 W. C. F.	180	2050	2120	1850	26
.30 Remington Hi-Speed	110	2400	2520	2080	22
.30 Remington	125	2350	2450	2060	22
.30 Remington	160	2100	2170	1880	22
.30 Remington Express	165	2100	2170	1890	22
.30 Remington	170	2100	2170	1900	22
.30 Remington	180	2000	2070	1840	22
.30 Newton	180	2750	2830	2530	26

CARTRIDGE	BULLET WEIGHT	INST. VELOCITY IN F.S. AT 78 FT. ±25 F.S.	MUZZLE VEL. IN F.S.	REMAINING VEL. AT 100 YDS. IN F.S.	BARREL LENGTH
.30/03 Springfield	220	2150	2200	1990	24
.30/03 Springfield	225	2170	2230	2000	24
.300 H. & H. Magnum	180	2980	3030	2820	26
.300 H. & H. Magnum	180	2980	3060	2750	26
.300 H. & H. Magnum	220	2670	2730	2490	26
.300 Savage	150	2600	2660	2430	24
.300 Savage	180	2315	2380	2140	24
.300 Savage	200	2025	2120	1840	24
.30/06 Springfield Hi-Speed	110	3240	3380	2850	24
.30/06 Springfield	145	2760	2860	2490	24
.30/06 Springfield Hi-Speed	150	2900	2960	2720	24
.30/06 Springfield	150	2800	2880	2560	24
.30/06 Springfield Military	150	2640	2700	2470	24
.30/06 Springfield Mark I	173	2640	2700	2500	24
.30/06 Springfield	180	2640	2710	2430	24
.30/06 Springfield	180	2640	2690	2500	24
.30/06 Springfield	200	2450	2510	2260	24
.30/06 Springfield	220	2350	2410	2190	24
.30/06 Springfield	225	2250	2310	2050	24
.30/40 Krag	150	2600	2660	2430	28
.30/40 Krag	180	2410	2480	2210	28
.30/40 Krag	180	2410	2460	2250	28
.30/40 Krag	220	2030	2080	1870	28
.30/40 Krag	220	2140	2190	1980	28
.30/40 Krag	225	2050	2110	1880	28
.303 Savage	180	2025	2120	1840	26
.303 Savage	182	1925*	1970	1730	26
.303 Savage	190	1925*	1960	1740	26
.303 Savage	195	1925*	1960	1740	26
.303 British Mark VII	174	2400	2450	2260	26
.303 British Mark VI	215	2100	2160	1940	26
.32 Remington	110	2500	2630	2140	22
.32 Remington Express	165	2125	2200	1900	22
.32 Remington	170	2125	2200	1910	22
.32 Remington	180	2000	2070	1800	22
.32 Winchester Special	110	2500	2630	2140	26
.32 Winchester Special	165	2180	2260	1950	26
.32 Winchester Special	168	2180	2260	1950	26
.32 Winchester Special	170	2180	2260	1960	26
.32 Winchester Special	180	2125	2200	1910	26
.32 Winchester Self Loading	165	1350*	1390	1190	22
.32/20 Winchester	100	1235*	1280	1060	24
.32/20 Winchester Hi-Velocity	80	1950*	2050	1520	24
.32/20 Winchester Hi-Velocity	115	1560*	1600	1290	24
.32/20 High Velocity	100	1600*	1670	1280	24
.32/20 Standard	115	1235*	1280	1080	24
.32/40 Winchester	165	1400*	1440	1230	26
.32/40 Winchester Hi-Velocity	165	1900*	1950	1650	26
.33 Winchester	200	2100	2180	1870	24
.348 Winchester Express	200	2425	2520	2160	24
.348 Winchester Hi-Speed	150	2750	2880	2380	24

CARTRIDGE	BULLET WEIGHT	INST. VELOCITY IN F.S. AT 78 FT. ± 25 F.S.	MUZZLE VEL. IN F.S.	REMAINING VEL. AT 100 YDS. IN F.S.	BARREL LENGTH
.348 Winchester	210	2425	2510	2180	24
.35 Newton	250	2600	2670	2390	24
.35 Remington High Velocity	150	2250	2360	1930	22
.35 Remington	200	2100	2180	1870	22
.35 Remington	210	2000	2080	1770	22
.35 Winchester	250	2120	2160	1910	24
.35 Winchester Self Loading	180	1350*	1390	1170	22
.351 Winchester Self Loading	180	1800*	1850	1360	20
.375 Magnum (H. & H.)	235	2775	2860	2520	24
.375 Magnum (H. & H.)	270	2650	2720	2460	24
.375 Magnum (H. & H.)	300	2475	2540	2290	24
.38/40 Winchester	180	1225*	1270	1060	24
.38/40 Winchester	180	1270*	1310	1090	24
.38/40 Winchester High Velocity	145	1960*	2040	1600	24
.38/40 Winchester High Velocity	180	1700*	1770	1380	24
.38/55 Winchester	255	1285*	1320	1150	26
.38/55 Winchester High Velocity	255	1560*	1600	1370	26
.38/56 Winchester	255	1360*	1400	1210	26
.38/72 Winchester	275	1445*	1480	1300	24
.40/60 Winchester	210	1900*	1960	1590	30
.40/65 Winchester	260	1325*	1360	1170	30
.40/65 Winchester	260	1500*	1550	1300	30
.40/72 Winchester	330	1350*	1380	1230	26
.40/72 Winchester	300	1385*	1420	1240	24
.40/82 Winchester	260	1450*	1500	1260	26
.401 Winchester Self Loading	200	2040	2140	1750	20
.405 Winchester	300	2150	2220	1910	24
.43 Egyptian	400	1300*	1330	1170	35
.43 Spanish	375	1350*	1380	1230	32
.44 Winchester	200	1250*	1300	1070	24
.44 Winchester High Velocity	160	1875*	1980	1430	24
.44 Winchester High Velocity	200	1500*	1570	1220	24
.45/60 Winchester	300	1350*	1390	1170	30
.45/70 Winchester High Velocity	300	1825*	1880	1550	22
.45/70 Government	405	1285*	1310	1160	22
.45/70 Government	405	1300*	1330	1180	22
.45/70 Government	435	1250*	1280	1140	22
.45/90 Winchester	300	1480*	1530	1270	26
.50/110 Winchester	300	1550*	1610	1280	24

* Instrument velocity at 53 feet.

† Velocity values established in a rifle.

NOTE: These specifications represent Technical Committee recommendations, using crusher cylinders, length of ranges, piston diameters, tolerances and locations, method of handling ammunition, equipment, etc., as provided for in the Manual of Approved Practices of the Small Arms and Ammunition Manufacturers Institute.

CONVERSION TABLE METER/SECONDS (METRIC) TO FOOT/SECONDS (U.S. STANDARD)

ONE METER = [illegible] YDS. OR ONE METER = [illegible] FEET.

METERS		+10	+20	+30	+40	+50	+60	+70	+80	+90
0	00 00	32.82	65.61	98.43	131.22	164.04	196.86	229.65	262.47	295.26
100	328.08	360.90	393.69	426.51	459.33	492 12	524.94	557.73	590.55	623.37
200	656.16	688.98	721.77	754.59	787.41	820.20	853.02	885.81	918.63	951.45
300	984.24	1017.06	1049.88	1082.67	1115.49	1148.28	1181.10	1213.92	1246.71	1279.53
400	1312.32	1345.14	1377.96	1410.75	1443.57	1476.36	1509.18	1542.00	1574.79	1607.61
500	1640.43	1673.22	1706.04	1738.83	1771.65	1804.47	1837.26	1870.08	1902.87	1935.69
600	1968.54	2001.30	2034.12	2066.91	2099.73	2132.55	2165.34	2198.16	2230.98	2263.77
700	2296.59	2329.38	2362.20	2395.02	2427.81	2460.63	2493.42	2526.24	2559.06	2591.85
800	2624.67	2657.46	2690.28	2723.10	2755.89	2788.71	2821.53	2854.32	2887.14	2919.93
900	2952.75	2985.57	3018.36	3051.18	3083.97	3116.79	3149.61	3182.40	3215.22	3248.01
1000	3280.83	3313.65	3346.44	3377.26	3412.08	3444.87	3477.69	3510.48	3543.30	3576.12
1100	3608.94									

CONVERSION DATA (SUPPLEMENTAL) 1 TO 9 METERS

METERS	1	2	3	4	5	6	7	8	9
FEET	3.28	6.56	9.84	13.12	16.40	19.68	22.97	26.25	29.53

CAPT. PHILIP B. SHARPE [illegible]

EUROPEAN STANDARDS

Most European countries have long used the metric system. Many handloaders have occasion to refer to ballistic data in foreign ammunition catalogs, and will usually find velocities given in M/S or meters-per-second. The quick reference table below translates such velocities into the more understandable foot-second standards of English-speaking countries.

In addition, European temperature readings are usually given in Centigrade, or Celsius as it is called in Germany, after Anders Celsius, a Swedish astronomer who introduced the system. This system is based on the freezing and boiling points of water; thus 0° C. = 32° F. and 100° C. = 212° F. To convert degrees C. into degrees F., multiply degrees C. by 1.8 and add 32.

European cartridge pressures are listed in a variety of ways. England usually lists them in tons-per-square-inch. Germany usually lists them in Kg CM^2 or kilograms-per-square-centimeter. France and many other countries list pressures in At CM^2 or Atmospheres-per-square-centimeter. Conversion of the metric to the English system of pounds-per-square-inch is not difficult. A word of caution: The British ton is the long ton of about 2240 pounds. The German ton (*Tonne*) is still different -2204.6 pounds—and is often called the metric ton. In converting such pressure data these notes may be of assistance:

1 square cm.	= .155 sq. in.	1 sq. inch	= 6.4516 sq. cm.
1 ton per sq. in.	= 157.49 kg. $cm.^2$	1 kg. $cm.^2$	= .00635 ton per sq. in.
1 foot-pound	= .1382 mkg.	1 mkg.	= 7.233 foot-pounds
1 kg. $cm.^2$	= 14.224 lbs. sq. in.	1 At. $cm.^2$	= 14.7 lbs. sq. in.

DIAMETERS OF FACTORY BULLETS

September, 1948 (Some bullets are obsolete but may be available)

CODE: FMJ, Full Metal Jacket; HP, Hollow Point, Open Point or Cavity Point; SP, Soft Point; BT, Boat Tail; EXP, Expanding, which refers to various makes of Patented Expanding Points, Protected Points, etc.; Tube, Copper Tube Expanding; HSP, Hollow Soft Point; BzP, Bronze Point; SP-B, Soft-Point Boat-tail; REM, Remington UMC; WIN, Winchester; USC Co., United States Cartridge Company; WTCW, Western Tool & Copper Works, Oakland, Calif.; SISK, R. B. Sisk, Iowa Park, Texas.

Average diameters only are given; working tolerances allow .0005 inch either side in most calibers, but averaging .0003 inch in highly specialized calibers such as the .30/06. All weights in grains, and diameters in inches.

CARTRIDGE	TYPE	WEIGHT	WESTERN	WIN	REM	USC CO	PETERS	WTCW	SISK
5.5-mm. Velo Dog	FMJ	45	.....	.226	.....	.....	.....	.....	.....
.22 WCF	Lead	45	.....	.2275	.228	.....	.2285	.....	.....
.22 Hornet	FMJ	35	.....	.....	.....	.....	.....	.....	Any
"	SP	35	.....	.....	.....	.....	.....	.....	"
"	FMJ	40	.....	.....	.....	.....	.....	.....	"
"	SP	40	.....	.....	.....	.....	.....	.....	"
"	HP	45	.....	.....	.2245	.....	.2245	.....	.....
"	SP	45	.2245	.2245	.2245	.2245	.....	.....	.....
"	HP	46	.2245	.2245	.....	.....	.....	.....	.....
"	SP	55	.....	.....	.....	.....	.....	.....	Any
"	FMJ	55	.....	.....	.....	.....	.....	.....	"
"	FMJ	63	.....	.....	.....	.....	.....	.....	"
"	SP	63	.....	.....	.....	.....	.....	.....	"
.22 Savage	FMJ	35	.....		.....	.....	.....	.....	"
"	SP	35	.....	.....	.....	.....	.....	.....	"
"	FMJ	40	.....	.....	.....	.....	.....	.....	"
"	SP	40	.....	.....	.....	.....	.....	.....	"
"	FMJ	55	.....	.....	.....	.....	.....	.....	"
"	SP	55	.....	.....	.....	.....	.....	.....	"
"	FMJ	63	.....	.....	.....	.....	.....	.....	"
"	SP	63	.....	.....	.....	.....	.....	.....	"
"	SP	70	.2280	.226	.2280	.226	.2275	.....	.....
"	FMJ	70	.2280	.226	.2280	.226	.2275	.....	.....
.25/20 SS	Lead	86	.....	.258	.258	.258	.2575	.....	.....
"	SP	86	.....	.2575	.258	.2575	.2575	.....	.....
.25/20 SS Repeater	Lead	86	.....	.258	.258	.....	.2575	.....	.....
"	FMJ	86	.257	.2575	.258	.2575	.2575	.....	.....
"	SP	86	.257	.2575	.258	.2575	2575	.....	.....
"	FMJ	60	.....	.....	.258	.....	.....	.....	.....
"	HP	60	.257	.2575	.258	.2575	.2575	.....	.....
6-mm. Lee	SP	112	.....	.244	.....	.....	.....	.....	.....
.25 ACP	FMJ	50	.251	.2510	.251	.251	.2505	.....	.....
.25 REM	HP	87	.....	.257	.258	.....	.....	.....	.....
"	SP	100	.....	.....	.....	.257	.....	.....	.....
.25 REM BT	SP	117	.259	.....	.....	.....	.....	.....	.....
"	HP	117	.259	.....	.....	.....	.....	.....	.....
"	SP	117	.....	.258	.258	.....	.2575		.....
"	HP	117	.....	.....	.258	.....	.....	.....	.....
.257 Roberts	HP	87	.257	.257	.257	.....	257		.....
"	HP	100	.257	.257	.257	.....	.257	.....	.....
"	HP	117	257	.257	.257	.....	.257	.....	.....
25/35 WIN	HP	87	.....	.....	.256	.....			.....
"	HP	117	.....	.....	.256	.....		.....	.....
"	FMJ	117	.258	.257	.256	.257	.2565	.....	.....
"	SP	117	.....	.257	.256	.....	.2565	.....	.....
.25/35 WIN BT	SP	117	.258	.....	.....	.....	.....	.....	.....
"	HP	117	.258	.....	.....	.....	.....	.....	.....
"	SP	100	.....	.....	.....	.257	.....	.....	.....
.25/36 Marlin	SP	117	.....	.2575	.258	.....	.2565	.....	.....
.250 Savage	FMJ	87	.....	.2575	.....	.2575	257		.....
"	SP	87	.....	.2575	.....	.2575	.257	.....	
"	FMJ	86	.....	.....	.257	.....	.....	.....	.....
"	HP	87	.....	.....	.257	.....	.....	.....	.....

CARTRIDGE	TYPE	WEIGHT	WESTERN	WIN	REM	USC CO	PETERS	WTCW	SISK
.250 Savage	EXP	...	.....	.....	.....	.....	.257	.....	.....
"	FMJ	100	.258	.....	.....	.....	.257	.....	.....
"	HP	100	.258	.....	.257	.2575	.257	.....	.....
.256 New	HP	129	.264	.....	.....	.....	.....	.....	.....
.270 WIN	EXP	130	.....	.2775	.....	.....	277	.....	.....
.270 WIN BT	HP	130	.....	.278	.....	.....	.....	.....	.....
.270 WIN	HP	130	.....	.....	.2775	.....	.....	.....	.....
"	SP	130	.....	.....	.....	.2775	.....	.....	.....
"	SP	150	.278	.2775	.....	.....	.....	.....	.....
.275 H & H Mag. BT	SP	175	.284	.....	.....	.....	.....	.....	.....
7 mm. Mauser	FMJ	139	.284	.....	2843	.....	.....	.....	.....
"	HP	139	284	.....	2843	.....	.....	.....	.....
"	FMJ	175	.284	.284	2843	284	.283	.....	.....
"	SP	175	.....	.284	.2843	.284	.283	.....	.....
7 mm. Mauser BT	SP	175	.284	.....	.....	.....	.....	.....	.....
.280 Ross	EXP	150	.....	.287	.....	.....	.....	.....	.....
"	Tube	145	.....	.....	.....	.287	.....	.....	.....
7.63 mm. Mauser	FMJ	86	.3088	.3105	.309	3105	.....	.....	.....
"	HSP	86	.....	.3105	.....	.....	.....	.....	.....
"	SP	86	3088	.....	.....	.3105	.....	.....	.....
"	SP	90	.....	.....	.309	.....	.....	.....	.....
6.5 mm. Mannlicher	HP	129	.264	.....	.....	.....	.....	.....	.....
"	HP	123	.....	.....	.....	.....	263	.....	.....
"	SP	160	.264	.....	.....	.....	.....	.....	.....
"	HP	160	.....	.....	.....	.....	.263	.....	.....
"	SP	145	.....	.....	.....	.264	.....	.....	.....
7.65 mm. Luger	FMJ	93	.3095	.3095	.309	.....	.3075	.....	.....
"	FMJ	94	.....	.....	.....	.3095	.....	.....	.....
"	SP	93	.3095	.....	309	.....	.3075	.....	.....
"	SP	94	.....	.....	.....	.3095	.....	.....	.....
"	HP	93	.....	.....	.309	.....	.3075	.....	.....
"	HSP	93	.....	.3095	.....	.....	.....	.....	.....
8 mm. Mannlicher	SP	200	.3220	.....	.....	.....	.....	.....	.....
.30 Newton BT	HP	180	.3088	.....	.....	.....	.....	.....	.....
.30 REM Auto	SP	170	.....	.306	307	.306	.306	.....	.....
.30 REM Auto BT	SP	170	.307	.....	.....	.....	.....	.....	.....
.30 REM Auto	FMJ	160	.307	.306	307	.306	306	.....	.....
.30 REM Auto BT	HP	165	.307	.....	.....	.....	.....	.....	.....
"	HP	110	.....	.....	307	.....	.....	.....	.....
"	HP	165	.....	.....	307	.....	.306	.....	.....
"	HP	125	.....	.....	.....	.....	306	.....	.....
.30 WCF	HP	110	.....	3085	307	.....	.....	.....	.....
"	FMJ	170	.....	.3085	.....	.....	.....	.....	.....
.30 WCF BT	FMJ	170	.307	.....	.....	.....	.....	.....	.....
"	SP	170	.....	.3085	.307	.3085	.3065	.....	.....
.30 WCF BT	SP	170	.3075	.....	.....	.....	.....	.....	.....
"	HP	165	.....	.....	307	.....	.....	.....	.....
"	HP	150	.307	.....	.....	.....	.....	.....	.....
"	FMJ	160	.....	.....	.307	.3085	.3065	.....	.....
"	HP	125	.....	.....	.....	.....	.3065	.....	.....
.30/40 Krag	FMJ	220	.3088	.3085	.3085	3085	3084	.....	.....
"	SP	220	.....	.309	.3085	.3085	3084	.....	.....
"	BzP	180	.....	.....	.3085	.....	.....	.....	.....
"	SP	180	.3088	.....	.3085	.....	3084	.....	.....
"	HP	220	.....	.....	.3085	.....	.....	.....	.....
"	EXP	150	.....	.3085	.....	.....	.3084	.....	.....
"	EXP	180	.....	.3085	.....	.....	.3084	.....	.....
.30/40 Krag BT	FMJ	180	.3088	.....	.....	.....	.....	.....	.....
"	HP	180	.3088	.....	.....	.....	.....	.....	.....
"	SP	220	.3088	.....	.....	.....	.....	.....	.....
"	Tube	180	.....	.....	.....	.3085	.....	.....	.....
"	SP	150	.....	.....	.....	.....	3084	.....	.....
"	HP	180	.....	.....	.....	.....	.3084	.....	.....
.30/06	HP	110	.....	.....	.3085	.....	.....	.....	.....
"	BzP	150	.....	.....	3085	.....	.....	.....	.....
"	BzP	180	.....	.....	.3085	.....	.....	.....	.....
30/06 BT	FMJ	173	.3088	.3085	.3087	.....	3084	.....	.....
.30/06	SP	190	.....	.....	.3085	.....	.....	.....	.....
"	FMJ	220	.3088	.....	3085	.....	.....	.....	.....
"	SP	220	.....	.309	.3085	.309	.3084	.....	.....
"	HP	220	.....	.....	.3085	.....	.....	.....	.....
"	FMJ	150	.3088	.3085	.....	.3085	.3084	.....	.....
"	EXP	150	.....	.3085	.....	.....	3084	.....	.....

CARTRIDGE	TYPE	WEIGHT	WESTERN	WIN	REM	USC CO	PETERS	WTCW	SISK
.30/06	FMJ	180	.....	.3085	.....	.....	3084	.....	.....
"	EXP	180	.....	.....	.....	.....	.3084	.....	.....
.30/06 Flat Nose	FMJ	220	.3088	.....	.....	.....	.....	.....	.....
.30/06 BT	SP	220	.3088	.....	.....	.....	.....	.....	.....
.30/06	SP	180	.3088	.....	.....	.....	.3084	.....	.....
.30/06 Match	FMJ	180	.3088	.....	.....	.3085	.....	.....	.....
.30/06	HP	150	.3088	.....	.....	.....	.....	.....	.....
.30/06 BT	HP	180	.3088	.....	.....	.....	.....	.....	.....
.30/06	Tube	145	.....	.....	.....	.3085	.....	.....	.....
"	Tube	180	.....	.....	.....	.3085	.....	.....	.....
"	SP	150	.....	.....	.....	.....	.3084	.....	.....
"	HP	200	.....	.....	.....	.....	3084	.....	.....
"	SP-B	225	.....	.....	.....	.....	.3084	.....	.....
.300 H & H Mag. BT	SP	220	.3088	.....	.....	.....	.....	.....	.....
.300 Savage	SP	180	.3088	.....	.3085	.....	.....	.....	.....
"	HP	150	.3088	.....	.....	.....	.....	.....	.....
"	FMJ	150	.....	.3085	.3085	.3085	.....	.....	.....
"	SP	150	.....	.3085	.....	.3085	.....	.....	.....
"	BzP	150	.....	.....	.3085	.....	.....	.....	.....
"	EXP	150	.....	.....	.....	.....	.3084	.....	.....
"	FMJ	180	.....	.....	.....	.....	.....	.....	.....
"	EXP	180	.....	.....	.....	.....	.3084	.....	.....
7.62 mm. Russian	BzP	150	.....	.....	.310	.....	.....	.....	.....
"	Tube	145	.....	.....	.....	.3085	.....	.....	.....
.303 British	FMJ	215	.....	.3125	.311	.....	312	.....	.....
"	SP	215	.....	.3125	.311	.....	.312	.....	.....
.303 British BT	SP	190	.312	.....	.....	.....	.....	.....	.....
"	HP	174	.312	.....	.....	.....	.....	.....	.....
.303 British	Tube	180	.....	.....	.....	.3125	.....	.....	.....
.303 Savage	SP	190	.3088	.3085	.....	.....	.3084	.....	.....
"	FMJ	190	.3088	.3085	.....	.....	.3084	.....	.....
"	FMJ	180	.....	.....	.....	.3085	.....	.....	.....
"	FMJ	182	.....	.....	.311	.....	.....	.....	.....
"	SP	195	.....	.....	.311	.....	.....	.....	.....
7.65 mm. Mauser	SP	216	.....	.....	.312	.....	.....	.....	.....
"	SP	215	.....	.3115	.....	.....	.....	.....	.....
"	FMJ	154	.....	.....	.312	.....	.....	.....	.....
"	SP	219	.....	.....	.....	.....	.3115	.....	.....
8 mm. (7.9) Mauser	SP	236	.....	.321	.323	.....	.....	.....	.....
"	FMJ	227	.....	.321	.....	.....	.....	.....	.....
"	SP	170	.321	.321	.323	.....	.323	.....	.....
8-mm. MS	SP	200	.322	.....	.....	.....	.323	.....	.....
"	SP	170	.....	.....	.323	.....	.....	.....	.....
.32 S. & W.	Lead	85	.314	.315	.....	.....	.....	.....	.....
"	MP	85	.314	.315	.315	.....	.....	.....	.....
"	Lead	88	.....	.....	.315	.....	.....	.....	.....
"	Lead	86	.....	.....	.....	.....	.3135	.....	.....
"	MP	86	.....	.....	.....	.....	.3135	.....	.....
"	FMJ	86	.....	.....	.....	.315	.....	.....	.....
"	Lead	87	.....	.....	.....	.315	.....	.....	.....
.32 ACP	FMJ	73	.....	.....	.....	.....	.311	.....	.....
"	FMJ	75	.....	.....	.....	.3125	.....	.....	.....
"	FMJ	71	.....	.....	.312	.....	.....	.....	.....
"	FMJ	74	.312	.3125	.....	.....	.....	.....	.....
.32 S. & W. Long	Lead	98	.314	.315	.315	.315	3135	.....	.....
"	MP	95	.....	.315	.315	.....	.....	.....	.....
"	MP	98	.314	.....	.....	.....	.3135	.....	.....
"	FMJ	98	.....	.....	.....	.315	.....	.....	.....
"	Wad-cutter	98	.....	.....	.....	.....	.3135	.....	.....
.32 Short Colt	Lead	80	.....	.315	.311	.315	.....	.....	.....
"	Lead	82	.....	.....	.....	.....	.299	.....	.....
.32 Long Colt	Lead	82	.....	.....	.302	.....	.3005	.....	.....
"	Lead	87	.....	.....	.....	.311	.....	.....	.....
.32 Colt NP	Lead	98	.....	.314	.....	.....	.....	.....	.....
"	MP	98	.....	.314	.315	.....	.....	.....	.....
"	Lead	100	.....	.....	.315	.314	.3135	.....	.....
"	MP	96	.....	.....	.....	.....	.3135	.....	.....
.32/20 WCF	Lead	100	.....	.3125	.3111	.....	.311	.....	.....
"	FMJ	100	.....	.....	.3111	.....	.311	.....	.....
"	SP	100	.....	.....	.3111	.....	.311	.....	.....
"	HP	80	.312	.3125	.3111	.3125	.311	.....	.....
"	FMJ	115	.312	.3125	.....	.3125	.....	.....	.....

CARTRIDGE	TYPE	WEIGHT	WESTERN	WIN	REM	USC CO	PETERS	WTCW	SISK
.32/20 WCF	SP	115	.312	.3125	.....	.3125	.....	.....	.....
"	Lead	115	.....	.....	.....	.3125		.....	.....
"	Lead	75	.....	.....	.....	.3125	.....	.....	.....
.32 WIN Special	FMJ	170	.322	.321	.....	321	.....	.....	.....
"	SP	170	.....	.321	.321	.321	.....	.....	.....
"	HP	110	.....	.321	321	.....		.....	.....
.32 WIN Special BT	SP	170	.322	.....	.....	.....	.....	.....	.....
"	HP	165	.322	.....	.....	.....	.....	.....	.....
.32 WIN Special	FMJ	168	.....	.....	321	.....	.....	.....	.....
"	HP	165	.....	.....	.321	.....	.....	.....	.....
"	SP	165	.....	.....	.....	.....	3205	.....	.....
"	FMJ	165	.....	.....	.....	.....	3205	.....	.....
.32 WIN SL	SP	165	.322	.322	.322	.322	.321	.....	.....
.32 REM Auto BT	SP	170	.321	.....	.....	.....	.....	.....	.....
.32 REM Auto	SP	170	.....	.....	.321	.....	.....	.....	
"	HP	110	.....	.321	.321	.....	.....	.....	.....
"	HP	165	.....	.....	.321	.....	.....	.....	.....
"	SP	165	.....	.321	.....	.321	.3205	.....	.....
.32 REM Auto BT	HP	165	.321	.....	.....	.....	.....	.....	.....
.32 /40	Lead	164	.....	.....	.320	.....		.....	.....
"	SP	165	.....	.321	.320	.321	.3205	.....	.....
.32 /40 BT	SP	165	.321	.....	.....	.....	.....	.....	.....
.32 /40	Lead	165	.....	.321	.....	.321	3195	.....	.....
.32 /40 BT	HP	175	.321	.....	.....	.....		.....	.....
.33 WCF	SP	200	.3385	.3385	.3365	.3385	3375	.....	.....
"	FMJ	200	.....	.3385	.....	.....	.....	.....	.....
.348 WIN	SP	150	.3492	.3492	.....	.....	.....	.....	.....
"	SP	200	.3492	.3492	.....	.....	.....	.....	.....
.35 Newton	HP	250	.357	.....	.....	.....	.....	.....	.....
.35 WIN SL	SP	180	.351	.351	.352	.351	.351	.....	.....
.35 WIN	FMJ	180	.....	.352	.....	.....	.....	.....	.....
.351 WIN SL	FMJ	180	.352	.352	.....	.352	.351	.....	.....
.351 WIN	SP	180	.352	352	.352	.352	.351	.....	.....
"	FMJ	177	.....	.....	.352	.....	.....	.....	.....
.35 WCF	SP	250	.359	.359	.358	.359	.3585	.....	.....
"	FMJ	250	.....	.359	.....	.....	.....	.....	.....
.35 REM	SP	200	.359	.3585	.359	.3585	3585	.....	.....
"	FMJ	200	.....	.3585	.....	.....	.....	.....	.....
"	HP	150	.....	.....	.359	.....	.....	.....	.....
"	HP	180	.....	.....	.359	.....	.....	.....	.....
"	HP	200	.359	.....	.....	.....	3585	.....	.....
.35 S. & W. Auto	MP	76	.....	3205	.3225	.....	3205	.....	.....
9 mm. Luger	FMJ	125	.354	.3555	.....	3555	.354	.....	.....
"	HSP	125	.354	.3555	.....	.3555	.....	.....	.....
"	HP	125	.....	.....	.....	.....	.354	.....	.....
"	FMJ	124	.....	.....	.355	.....	.....	.....	.....
"	HP	124	.....	.....	355	.....	.....	.....	.....
.375 H & H Mag.	SP	270	.3755	.....	.....	.....	.....	.....	.....
"	SP	300	.3755	.....	.....	.....	.....	.....	.....
"	HP	235	.3755	.....	.....	.....	.....	.....	.....
.380 ACP	FMJ	95	.3565	.3565	357	.357	3555	.....	.....
.38 ACP	HSP	130	.....	.356	.....	.....	.....	.....	.....
"	FMJ	130	.359	.356	.357	.359	.3585	.....	.....
"	HP	130	.....	.....	.356	.359	.3585	.....	.....
.38 S. & W.	Lead	145	.359	.359	.....	.....	.....	.....	.....
"	MP	145	.359	.359	.....	.....		.....	.....
"	Lead	146	.....	.....	.361	.....	.3585	.....	.....
"	MP	143	.....	.....	.361	.....	.....	.....	.....
"	MP	146	.....	.....	.....	.....	.3585	.....	.....
"	Lead	150	.....	.....	.....	.359	.....	.....	.....
"	Lead	200	.359	.359	.....	.....	.3585	.....	.....
"	FMJ	147	.....	.....	.....	.359	.....	.....	.....
.38 S. & W. Special	Lead	158	.359	.3585	.358	.....	.3575	.....	.....
"	Lead	200	.359	.3585	.358	.....	.3575	.....	.....
"	MP	158	.358	.358	.358	.....	3575	.....	.....
"	Lead	150	.359	.....	.....	.....	.....	.....	.....
"	MP	150	.359	.....	.....	.....	.....	.....	.....
"	WC	145	.359	.....	.....	.....	.....	.....	.....
"	WC	148	.....	.3585	.....	.....	.....	.....	.....
"	WC	132	.....	.....	.358	.....	.....	.....	.....
"	WC	147	.....	.....	.....	.3585	.3575	.....	.....
"	Lead	164	.....	.....	.....	.3585	.....	.....	.....
"	FMJ	155	.....	.....	.....	.3585	.....	.....	.....
.38 Colt NP	Lead	150	.....	.359	.361	.359	.3585	.....	.....

CARTRIDGE	TYPE	WEIGHT	WESTERN	WIN	REM	USC CO	PETERS	WTCW	SISK
.38 Short Colt	Lead	130	....	.375	....	....	....	....	....
"	Lead	125	....	....	.375	....	3735	....	....
"	Lead	128	....	....	....	.375	....	....	....
.38 Long Colt	Lead	150	....	.358	.358	....	3575	....	....
"	MP	148	....	....	....	....	.3575	....	....
"	Lead	148	....	....	....	.358	....	....	....
.38 Colt Special	Lead	158	358	358	.358	....	3575	....	....
"	MP	158	....	....	.358	....	.3575	....	....
"	Lead	164	....	....	....	.359	....	....	....
9 mm. Mauser	SP	280	....	.358	.358	....	....	....	....
.38/40 WCF	Lead	180	....	.400	.400	....	3995	....	....
"	MC	180	.401	.3995	....	3995	3995	....	....
"	SP	180	.401	.3995	.4005	.3995	3995	....	....
"	MC	178	....	....	.4005	....	....	....	....
"	HP	130	....	....	4005	....	....	....	....
.38/55	Lead	255	....	.377	.377	.377	376	....	....
"	SP	255	.377	.377	.377	377	.376	....	....
"	HP	255	....	....	.377	....	....	....	....
"	MC	255	.377	....	....	....	....	....	....
.38/56 WCF	SP	255	....	.377	377	....	3785	....	....
.40/60 WCF	Lead	210	....	.404	.406	....	....	....	....
.40/65 WCF	SP	260	....	.406	.406	....	.404	....	....
.40/72 WCF	SP	330	....	....	.406	....	....	....	....
"	SP	300	....	.407	....	....	....	....	....
.40/82 WCF	SP	260	....	.406	406	....	4055	....	....
.401 WIN SL	SP	200	.406	407	.407	....	.4065	....	....
"	SP	250	....	.407	.407	....	4065	....	....
.405 WIN	SP	300	.411	.412	.412	....	4105	....	....
"	MC	300	....	.412	....	....	....	....	....
.41 Short Colt	Lead	163	....	....	.406	....	....	....	....
"	Lead	160	....	.406	....	....	.3855	....	....
"	Lead	167	....	....	....	406	....	....	....
.41 Long Colt	Lead	195	....	....	.406	....	.3855	....	....
"	Lead	200	....	....	....	387	....	....	....
"	Lead	196	....	.387	....	....	....	....	....
.43 Egyptian	Lead	400	....	....	.453	....	....	....	....
.43 Baumont	Lead	400	....	....	.453	....	....	....	....
.43 Spanish	Lead	375	....	....	436	....	....	....	....
11 mm. Mauser	Lead	386	....	....	.438	....	....	....	....
.44 Henry Flat	Lead	200	....	.423	....	....	....	....	....
.44 S. & W. American	Lead	205	....	.420	....	....	.4185	....	....
"	Lead	218	....	....	.439	....	....	....	....
"	Lead	207	....	....	....	420	....	....	....
.44 Russian	Lead	246	.4325	.4325	.432	.431	4325	....	....
"	MP	246	.431	.431	432	....	.4325	....	....
.44 Special	Lead	246	.431	.431	.432	.431	.4325	....	....
"	MP	246	.431	.431	432	.431	.4325	....	....
.44 Colt	Lead	210	....	....	.448	448	....	....	....
.44/40 WCF	Lead	200	....	.4255	426	.4255	.4255	....	....
"	MC	197	....	....	4255	....	....	....	....
"	SP	200	.427	.4255	.4255	.4255	4225	....	....
"	HP	140	....	....	4255	....	....	....	....
"	MC	200	.427	.4255	....	.4255	4225	....	....
.44 Webley	Lead	200	....	.426	436	426	.4235	....	....
.45 Bulldog	Lead	170	....	....	.436	.426	....	....	....
"	Lead	168	....	....	....	....	4235	....	....
.45 Webley	Lead	230	....	.4505	450	....	....	....	....
.45 S. & W.	Lead	250	....	....	.454	....	....	....	....
.45 Colt	Lead	250	....	4545	.454	.455	....	....	....
"	Lead	255	....	....	....	....	.4535	....	....
.45 ACP	MC	230	.4515	4505	4515	4505	4507	....	....
.45 Auto RIM	Lead	230	.4515	.4505	.4505	4515	4535	....	....
"	MC	230	.4515	.4505	.4505	.4515	.4507	....	....
.450 Revolver	Lead	226	....	....	.458	....	....	....	....
455 Webley MK II	Lead	265	....	.4545	.456	....	....	....	....
.45/60 WIN	Lead	300	....	....	458	....	4565	....	....
.45/70 WIN	Lead	405	....	.458	.458	....	4575	....	....
"	SP	432	....	....	....	.458	....	....	....
"	SP	435	....	....	.458	....	....	....	....
"	SP	300	....	.456	458	.456	....	....	....
"	SP	405	.458	....	....	....	4595	....	....
.45/75 WCF	Lead	350	....	.4575	....	....	....	....	....
.45/90 WCF	SP	300	....	.4575	.458	....	....	....	....
.50/70 WCF	Lead	450	....	....	.515	....	....	....	....
.50/110 WCF	Lead	300	....	.513	....	....	....	....	....

MATERIALS

Melting Points

The table, "Specific Gravity and Properties of Metals," gives the melting points of the more common commercial metals. The melting points of commercial metals vary, however, because of slight impurities, and should therefore be considered approximate only. The melting points of nearly all chemical elements in their pure state are given in the table "Melting Points of Chemical Elements." The data here given are accepted by the United States Bureau of Standards as the most carefully determined and most probably correct. In the table, the Fahrenheit temperatures are exact conversions from the Centigrade scale, but it should be understood that melting points above 2000 degrees F. are not known exactly to within 5 or 10 degrees. Impure metals usually have lower melting points than pure metals. The melting point of an alloy cannot always be directly inferred from the melting points of its component elements.

Melting Points of Chemical Elements

Chemical Element	Melting Point Deg. C.	Melting Point Deg. F.	Specific Gravity	Wt. Per Cu. In. Pounds	Alloys	Specific Gravity	Wt. Per Cu. In. Pounds
Aluminum	659	1218	2.56	0.0924			
Antimony	630	1166	6.71	0.2422			
Argon	−188	−306	....	......			
Arsenic	850	1562	.....	......			
Barium	850	1562	3.75	0.1354			
Beryllium	1800	3272	.....	......			
Bismuth	271	520	9.80	0.3538			
Boron	2200	3992	2.60	0.0939			
Bromine	−7	+19	....	......	Brass 80C., 20Z	8.60	0.3105
Cadmium	321	610	8.60	0.3105	70C., 30Z	8.40	0.3032
Caesium	26	79	.....	......	60C., 40Z	8.36	0.3018
Calcium	810	1490	1.57	0.0567	50C., 50Z	8.20	0.2960
Cerium	640	1184	.....	...	(Copper and Zinc)		
Chlorine	−102	−152	.....	....			
Chromium	1510	2750	6.50	0.2347	Bronze	8.85	0.3195
Cobalt	1490	2714	8.65	0.3123			
Copper	1083	1981	8.82	0.3184			
Fluorine	−223	−369	.....	......			
Gallium	30	86	.....	......			
Germanium	958	1756	.....	......			
Gold	1063	1945	19.32	0.6975			
Helium	−267	−449	.	..			
Hydrogen	−258	−432	...	......			
Indium	155	311	...	......			
Iodine	114	237	.....	......			
Iridium	2300	4172	22.42	0.8094	Iron		
Iron	1520	2768	7.20	0.2600	(cast)	7.20	0.2600
Krypton	−169	−272	...	......	(wrought)	7.85	0.2834
Lanthanum	810	1490	.....	......			
Lead	327	621	11.37	0.4105			
Lithium	186	367	.	.			
Magnesium	651	1204	1.74	0.0628			
Manganese	1225	2237	7.42	0.2679			
Mercury (60° F.)	−39	−38	13.58	0.4902			
Molybdenum	2500	4532	8.56	0.3090			
Neodymium	840	1544	.....	......			
Neon	−253	−423	.....	......			
Nickel	1452	2646	8.80	0.3177			
Niobium	2200	3992	.....	......			
Nitrogen	−210	−346	...	....			
Osmium	2700	4892	.....	......			
Oxygen	−235	−391	.....	......			
Palladium	1550	2822	.....	......			
Phosphorus	44	111	....	.	Platinum		
Platinum	1755	3191	22.67	0.8184	(rolled)	22.69	0.8184
Potassium	62	144	0.87	0.0314	(wire)	21.04	0.7595
Praesodymium	940	1724	.....	......			
Rhodium	1940	3524	.....	......			

Chemical Element	MELTING POINT		Specific Gravity	Wt. Per Cu. In. Pounds	ALLOYS	Specific Gravity	Wt. Per Cu. In. Pounds
	Deg. C	Deg. F.					
Rubidium	38	100	.....	.....			
Ruthenium	1950	3542	.....	.....			
Samarium	1300	2372	.....	.....			
Scandium	1400	2552	.....	.....			
Selenium	217	423	.....	.....			
Silicon	1420	2588	.....	.....			
Silver	961	1762	10.53	0.3802			
Sodium	97	207	0.98	0.0354	Steel	7.80	0.2816
Strontium	830	1525	.....	.....			
Sulphur	113	235	.....	.....			
Tantalum	2850	5162	.....	.....			
Tellurium	452	846	6.25	0.2256			
Thallium	302	576	.....	.....			
Thorium	1700	3092	.....	.....			
Tin	232	450	7.29	0.2632			
Titanium	1900	3452	3.54	0.1278			
Tungsten	3000	5432	18.77	0.6776			
Uranium	2400	4352	.....	.....			
Vanadium	1750	3182	5.50	0.1986			
Xenon	−140	−220	.....	.....			
Ytterbium	1800	3272	.....	.....			
Yttrium	1250	2282	.....	.....	Zinc		
Zinc	419	786	6.86	0.2476	(cast)	6.86	0.2476
Zirconium	1700	3092	.....	.....	(rolled)	7.15	0.2581

DECIMAL EQUIVALENTS OF FRACTIONS OF AN INCH

1/64	0.015625
1/32	0.03125
3/64	0.046875
1/16	0.0625
5/64	0.078125
3/32	0.09375
7/64	0.109375
1/8	0.125
9/64	0.140625
5/32	0.15625
11/64	0.171875
3/16	0.1875
13/64	0.203125
7/32	0.21875
15/64	0.234375
1/4	0.250
17/64	0.265625
9/32	0.28125
19/64	0.296875
5/16	0.3125
21/64	0.328125
11/32	0.34375
23/64	0.359375
3/8	0.375
25/64	0.390625
13/32	0.40625
27/64	0.421875
7/16	0.4375
29/64	0.453125
15/32	0.46875
31/64	0.484375
1/2	0.500
33/64	0.515625
17/32	0.53125
35/64	0.546875
9/16	0.5625
37/64	0.578125
19/32	0.59375
39/64	0.609375
5/8	0.625
41/64	0.640625
21/32	0.65625
43/64	0.671875
11/16	0.6875
45/64	0.703125
23/32	0.71875
47/64	0.734375
3/4	0.750
49/64	0.765625
25/32	0.78125
51/64	0.796875
13/16	0.8125
53/64	0.828125
27/32	0.84375
55/64	0.859375
7/8	0.875
57/64	0.890625
29/32	0.90625
59/64	0.921875
15/16	0.9375
61/64	0.953125
31/32	0.96875
63/64	0.984375

MEASURES OF WEIGHT

AVOIRDUPOIS OR COMMERCIAL WEIGHT

1 gross or long ton equals 2240 pounds.
1 net or short ton equals 2000 pounds.
1 pound equals 16 ounces equals 7000 grains.
1 ounce equals 16 drachms equals 437.5 grains.

The following measures for weight are now seldom used in the United States:

1 hundredweight equals 4 quarters equals 112 pounds (1 gross or long ton equals 20 hundredweights); 1 quarter equals 28 pounds; 1 stone equals 14 pounds; 1 quintal equals 100 pounds.

TROY WEIGHT, USED FOR WEIGHING GOLD AND SILVER

1 pound equals 12 ounces equals 5760 grains.
1 ounce equals 20 pennyweights equals 480 grains.
1 pennyweight equals 24 grains.
1 carat (used in weighing diamonds) equals 3.168 grains.
1 grain Troy equals 1 grain avoirdupois equals 1 grain apothecaries' weight.

APOTHECARIES' WEIGHT

1 pound equals 12 ounces equals 5760 grains.
1 ounce equals 8 drachms equals 480 grains.
1 drachm equals 3 scruples equals 60 grains.
1 scruple equals 20 grains.

COMPARATIVE TABLE OF WEIGHTS FOR CONVERTING GRAMS INTO GRAINS

Grams = g	00	.10	.20	.30	.40	.50	.60	.70	.80	.90
1	15.4	16.9	18.5	20.1	21.6	23.1	24.7	26.2	27.8	29.3
2	30.9	32.4	34.0	35.5	37.0	38.6	40.1	41.7	43.2	44.8
3	46.3	47.8	49.4	50.9	52.5	54.0	55.6	57.1	58.6	60.2
4	61.7	63.3	64.8	66.4	67.9	69.4	71.0	72.5	74.1	75.6
5	77.2	78.7	80.2	81.8	83.3	84.9	86.4	88.0	89.5	91.0
6	92.6	94.1	95.7	97.2	98.8	100.3	101.9	103.4	104.9	106.5
7	108.0	109.6	111.1	112.7	114.2	115.7	117.3	118.8	120.4	121.9
8	123.5	125.0	126.5	128.1	129.6	131.2	132.7	134.3	135.8	137.3
9	138.9	140.4	142.0	143.5	145.1	146.6	148.1	149.7	151.2	152.8
10	154.3	155.9	157.4	159.0	160.5	162.0	163.6	165.1	166.7	168.2
11	169.8	171.3	172.8	174.4	175.9	177.5	179.0	180.6	182.1	183.6
12	185.2	186.7	188.3	189.8	191.4	192.9	194.4	196.0	197.5	199.1
13	200.6	202.2	203.7	205.2	206.8	208.3	209.9	211.4	213.0	214.5
14	216.0	217.6	219.1	220.7	222.2	223.8	225.3	226.9	228.4	229.9
15	231.5	233.0	234.6	236.1	237.7	239.2	240.7	242.3	243.8	245.4
16	246.9	248.5	250.0	251.5	253.1	254.6	256.2	257.7	259.3	260.8
17	262.3	263.9	265.4	267.0	268.5	270.1	271.6	273.1	274.7	276.2
18	277.8	279.3	280.9	282.4	283.9	285.5	287.0	288.6	290.1	291.7
19	293.2	294.8	296.3	297.8	299.4	300.9	302.5	304.0	305.6	307.1
20	308.6	310.2	311.7	313.3	314.8	316.4	317.9	319.4	321.0	322.5
21	324.1	325.6	327.2	328.7	330.2	331.8	333.3	334.9	336.4	338.0
22	339.5	341.0	342.6	344.1	345.7	347.2	348.8	350.3	351.9	353.4
23	354.9	356.5	358.0	359.6	361.1	362.7	364.2	365.7	367.3	368.8
24	370.4	371.9	373.5	375.0	376.5	378.1	379.6	381.2	382.7	384.3
25	385.8	387.3	388.9	390.4	392.0	393.5	395.1	396.6	398.1	399.7
26	401.2	402.8	404.3	405.9	407.4	408.9	410.5	412.0	413.6	415.1
27	416.7	418.2	419.8	421.3	422.8	424.4	425.9	427.5	429.0	430.6
28	432.1	433.6	435.2	436.7	438.3	439.8	441.4	442.9	444.4	446.0
29	447.5	449.1	450.6	452.2	453.7	455.2	456.8	458.3	459.9	461.4
30	463.0	464.5	466.0	467.6	469.1	470.7	472.2	473.8	475.3	476.8

FIGURING SHELL CAPACITIES

It is often necessary for the experimental handloader to know the exact volume of any particular cartridge case. If he is equipped with a pair of balances suitably sensitive, and an accurate set of weights, this can quickly be determined. First, block the primer pocket of the empty shell whose volume you desire to determine. This may be done with the new primer or by gently pressing in a small piece of putty or modeler's clay. The primer is generally the best bet. Then weigh the case carefully, noting its exact weight as closely as possible. Then by means of a glass eye-dropper fill the cartridge case level full of clean water. Again weigh the case, being careful not to get any water on the outside of it or to spill any of its contents. Simple subtraction will give you the weight of the water. By this method one finds that the .250/3000 Savage case holds 42 grains of water. One cubic inch of water weighs 252.777—infinity. A cubic centimeter (c.c.) of water weighs in grains 15.42915 grains. By mathematical calculation we determine that 42 grains of water equal .16615 cubic inch or 2.7221466 cubic centimeters. Thus is shell volume determined.

TABLE FOR CONVERTING MILLIMETERS INTO INCHES

(mm)	(Inches)	(mm)	(Inches)	(mm)	(Inches)
1	.039	.1	.004	.01	.00039
2	.079	.2	.008	.02	.00079
3	.118	.3	.012	.03	.00118
4	.157	.4	.016	04	.00157
5	.197	.5	.020	.05	.00197
6	.236	.6	.024	.06	.00236
7	.276	.7	.028	.07	.00276
8	.315	.8	.031	.08	.00315
9	.354	.9	.035	09	.00354
10	.394	1.0	.039	.10	.00394
11	.433	1.1	.043	.11	.00433
12	.472	1.2	.047	.12	.00472
13	.512	1.3	.051	.13	.00512
14	.551	1 4	.055	.14	.00551
15	.591	1.5	.059	.15	.00591
16	.630	1.6	.063	.16	.00630
17	.669	1.7	.067	.17	.00669
18	.709	1.8	.071	.18	.00709
19	.748	1.9	.075	.19	.00748
20	.787	2.0	.079	.20	.00787

"METRIC" AND "U. S." CONSTANTS—*Conversion Factors*

Millimeters	× .03937	Inches	Cubic cm.	× 16.383	Cubic inches
"	× 25.4	"	" "	× 3.69	Fluid drachms
Centimeters	× .3937	"	" "	× 29.57	Fluid ounces
"	× 2.54	"	Grams	× 15.4324	Grains (Act of Congress)
Meters	× 39.37	" (Act of Congress)	" (water)	× 29.57	Fluid ounces
"	× 3.281	Feet	Grams	× 28.35	Ounces avoirdupois
"	× 1.094	Yard	Kilograms	× 2.2046	Pounds
Square mm.	× .0155	Square inches	"	× 35.3	Ounces avoirdupois
" "	× 645.1	" "	Kilograms per sq. cm. (Atmosphere)	× 14.223	Pounds per sq. in.
Square cm.	× .155	" "	Kilogrammeters	× 7.233	Foot-pounds
" "	× 6.451	" "			

TO DETERMINE THE ENERGY OF A BULLET

Assuming we know the weight of the bullet and its velocity and desire to know the striking energy in foot-pounds, the following short method is very efficient:

Square the velocity of the bullet in foot-seconds. Divide this result by 7000 to reduce it from grains to pounds. Divide this quotient by twice the acceleration of gravity, or 64.32. This will give the striking energy in foot-pounds of each grain of bullet weight. Multiply this result by the weight of the bullet in grains and you have the striking energy of the bullet in foot-pounds.

RULES IN MENSURATION

To find the area of a circle, the diameter being known:

Square the diameter and multiply by .7854.

To find the circumference of a circle, the diameter being known:

Multiply the diameter by 3.1416.

To find the convex surface of a sphere:

Square the diameter and multiply by 3.1416.

To find the cubic contents of a sphere:

Multiply the cube of the diameter by .5236.

To find the solid contents of a pyramid or cone:

Multiply the area of the base by one-third the altitude.

To find the solid contents of a frustrum of a pyramid or cone:

To the sum of the areas of the two ends add the square root of the product of these areas, and multiply the result by one-third of the altitude.

To find the solid contents of a prism or cylinder:

Multiply the area of the base by the altitude.

Similar areas are to each other as the squares of their like dimensions.

Similar solids are to each other as the cubes of their like dimensions.

TABLE OF ENERGIES

This table of energies has been worked out by application of the existing formula for computing energy and gives the foot-pounds of striking energy for one grain of bullet weight. The formula for using this table is simple: multiply the foot-pounds opposite the desired velocity by the weight of your bullet. Velocities have been carefully worked out for each increasing ten foot-seconds. For example, to obtain the energy of a 145-grain bullet at 2835 f.s. locate 2830 f.s. in the proper column and you find the energy to be 17.78 foot-pounds. The next figure is for 2840 f.s. and runs 17.91. Difference, .13 foot-pounds. Halve this and get .06, which, added to 17.78, gives 17.84. To get bullet energy, multiply 17.84 by 145 grains, and the figure is 2586.8 or 2587 foot-pounds. Use of this table saves much time in figuring muzzle or remaining energy of bullets.

Energies of Bullets

Velocity in f.s.	Energy Per Grain of Bullet Weight	Velocity in f.s.	Energy Per Grain of Bullet Weight
600	.80	1030	2.35
610	.82	1040	2.40
620	.85	1050	2.45
630	.88	1060	2.49
640	.91	1070	2.54
650	.94	1080	2.59
660	.96	1090	2.63
670	.99	1100	2.68
680	1.02	1110	2.73
690	1.05	1120	2.78
700	1.08	1130	2.83
710	1.11	1140	2.88
720	1.15	1150	2.93
730	1.18	1160	2.99
740	1.21	1170	3.04
750	1.24	1180	3.09
760	1.28	1190	3.14
770	1.31	1200	3.19
780	1.34	1210	3.25
790	1.38	1220	3.30
800	1.42	1230	3.36
810	1.45	1240	3.41
820	1.49	1250	3.47
830	1.53	1260	3.52
840	1.56	1270	3.58
850	1.60	1280	3.63
860	1.64	1290	3.69
870	1.68	1300	3.75
880	1.72	1310	3.81
890	1.76	1320	3.86
900	1.79	1330	3.92
910	1.83	1340	4.98
920	1.87	1350	4.04
930	1.92	1360	4.10
940	1.96	1370	4.16
950	2.00	1380	4.22
960	2.04	1390	4.29
970	2.08	1400	4.35
980	2.13	1410	4.41
990	2.17	1420	4.47
1000	2.22	1430	4.54
1010	2.26	1440	4.60
1020	2.31	1450	4.66

Velocity in f.s.	Energy Per Grain of Bullet Weight	Velocity in f.s.	Energy Per Grain of Bullet Weight
1460	4.73	2040	9.24
1470	4.79	2050	9.33
1480	4.86	2060	9.42
1490	4.93	2070	9.50
1500	5.00	2080	9.60
1510	5.06	2090	9.70
1520	5.13	2100	9.80
1530	5.19	2110	9.90
1540	5.26	2120	9.98
1550	5.33	2130	10.07
1560	5.40	2140	10.17
1570	5.47	2150	10.26
1580	5.54	2160	10.36
1590	5.61	2170	10.45
1600	5.68	2180	10.55
1610	5.75	2190	10.65
1620	5.82	2200	10.74
1630	5.90	2210	10.84
1640	5.97	2220	10.94
1650	6.04	2230	11.04
1660	6.12	2240	11.14
1670	6.19	2250	11.24
1680	6.26	2260	11.34
1690	6.34	2270	11.44
1700	6.41	2280	11.54
1710	6.49	2290	11.64
1720	6.57	2300	11.74
1730	6.64	2310	11.83
1740	6.72	2320	11.95
1750	6.80	2330	12.05
1760	6.88	2340	12.16
1770	6.95	2350	12.26
1780	7.03	2360	12.37
1790	7.11	2370	12.47
1800	7.19	2380	12.58
1810	7.27	2390	12.68
1820	7.35	2400	12.78
1830	7.43	2410	12.90
1840	7.51	2420	13.00
1850	7.60	2430	13.11
1860	7.68	2440	13.22
1870	7.76	2450	13.33
1880	7.84	2460	13.44
1890	7.93	2470	13.55
1900	8.01	2480	13.66
1910	8.10	2490	13.77
1920	8.18	2500	13.88
1930	8.37	2510	13.99
1940	8.35	2520	14.10
1950	8.44	2530	14.20
1960	8.53	2540	14.32
1970	8.61	2550	14.44
1980	8.70	2560	14.55
1990	8.79	2570	14.67
2000	8.88	2580	14.78
2010	8.97	2590	14.89
2020	9.06	2600	15.01
2030	9.15	2610	15.13

Velocity in f.s.	Energy Per Grain of Bullet Weight	Velocity in f.s.	Energy Per Grain of Bullet Weight
2620	15.24	3220	22.97
2630	15.36	3230	23.12
2640	15.48	3240	23.26
2650	15.59	3250	23.41
2660	15.71	3260	23.55
2670	15.83	3270	23.70
2680	15.96	3280	23.84
2690	16.07	3290	23.99
2700	16.19	3300	24.14
2710	16.31	3310	24.28
2720	16.43	3320	24.43
2730	16.55	3330	24.58
2740	16.67	3340	24.73
2750	16.79	3350	24.87
2760	16.91	3360	25.02
2770	17.04	3370	25.17
2780	17.16	3380	25.32
2790	17.28	3390	25.47
2800	17.41	3400	25.62
2810	17.53	3410	25.77
2820	17.66	3420	25.93
2830	17.78	3430	26.08
2840	17.91	3440	26.23
2850	18.04	3450	26.38
2860	18.16	3460	26.54
2870	18.29	3470	26.69
2880	18.42	3480	26.85
2890	18.55	3490	27.00
2900	18.67	3500	27.16
2910	18.80	3510	27.31
2920	18.93	3520	27.47
2930	19.06	3530	27.62
2940	19.19	3540	27.78
2950	19.32	3550	27.94
2960	19.45	3560	28.10
2970	19.59	3570	28.25
2980	19.72	3580	28.41
2990	19.85	3590	28.57
3000	20.00	3600	28.73
3010	20.12	3610	28.94
3020	20.25	3620	29.10
3030	20.39	3630	29.26
3040	20.52	3640	29.42
3050	20.66	3650	29.58
3060	20.79	3660	29.75
3070	20.93	3670	29.91
3080	21.07	3680	30.07
3090	21.16	3690	30.24
3100	21.29	3700	30.40
3110	21.43	3710	30.56
3120	21.57	3720	30.73
3130	21.71	3730	30.90
3140	21.85	3740	31.06
3150	21.99	3750	31.23
3160	22.12	3760	31.40
3170	22.26	3770	31.56
3180	22.41	3780	31.73
3190	22.55	3790	31.90
3200	22.69	3800	32.07
3210	22.83	3810	32.24

Velocity in f.s.	Energy Per Grain of Bullet Weight	Velocity in f.s.	Energy Per Grain of Bullet Weight
3820	32.41	4220	39.55
3830	32.58	4230	39.74
3840	32.75	4240	39.92
3850	32.92	4250	40.11
3860	33.09	4260	40.30
3870	33.26	4270	40.49
3880	33.45	4280	40.68
3890	33.62	4290	40.87
3900	33.78	4300	41.06
3910	33.95	4310	41.25
3920	34.12	4320	41.45
3930	34.30	4330	41.64
3940	34.48	4340	41.83
3950	34.65	4350	42.02
3960	34.82	4360	42.22
3970	35.00	4370	42.41
3980	35.18	4380	42.61
3990	35.36	4390	42.80
4000	35.53	4400	43.00
4010	35.71	4410	43.19
4020	35.89	4420	43.39
4030	36.07	4430	43.58
4040	36.25	4440	43.78
4050	36.43	4450	43.98
4060	36.61	4460	44.18
4070	36.79	4470	44.38
4080	36.97	4480	44.58
4090	37.15	4490	44.77
4100	37.33	4500	44.97
4110	37.51	4510	45.17
4120	37.70	4520	45.37
4130	37.88	4530	45.58
4140	38.06	4540	45.78
4150	38.25	4550	45.98
4160	38.43	4560	46.18
4170	38.62	4570	46.38
4180	38.80	4580	46.59
4190	38.99	4590	46.79
4200	39.18	4600	47.00
4210	39.36		

WEIGHT OF SQUARE AND ROUND STEEL BARS IN POUNDS PER LINEAR FOOT

Based on 489.6 lbs. per cubic foot. For wrought iron deduct 2 per cent. For high-speed steel add 11 per cent.

Thickness or Diameter Inches	Weight of Sq. Bar 1 Ft. Long	Weight of Round Bar 1 Ft. Long
1/32	.0033	.0026
1/16	.0133	.0104
1/8	.0531	.0417
3/16	.1195	.0938
1/4	.2123	.1669
5/16	.3333	.2608
3/8	.4782	.3756
7/16	.6508	.5111
1/2	.8500	.6676
9/16	1.076	.8449
5/8	1.328	1.043
11/16	1.608	1.262
3/4	1.913	1.502
13/16	2.245	1.763
7/8	2.603	2.044
15/16	2.989	2.347
1	3.400	2.670
1 1/16	3.838	3.014
1 1/8	4.303	3.379
1 3/16	4.795	3.766
1 1/4	5.312	4.173
1 5/16	5.857	4.600
1 3/8	6.428	5.019
1 7/16	7.026	5.518
1 1/2	7.650	6.008
1 9/16	8.301	6.520
1 5/8	8.978	7.051
1 11/16	9.682	7.604
1 3/4	10.41	8.178
1 13/16	11.17	8.773
1 7/8	11.95	9.388
1 15/16	12.76	10.02
2	13.60	10.68

TAP DRILLS—FINE THREAD STANDARD

American National Standard—Fine Thread

Size	Threads Per Inch	No. or Fraction	Decimal	Per Cent of Basic Depth
0	80	56	.047	83
1	72	53	.060	75
2	64	50	.070	79
3	56	46	.081	78
4	48	.	.091	77
5	44	38	.102	80
6	40	34	.111	83
		33	.113	77
8	36	29	.136	78
10	32	22	.157	81
		21	.159	76
12	28	15	.180	78
1/4	28	3	.213	80

Size	Threads Per Inch	No. or Fraction	Decimal	Per Cent of Basic Depth
5/16	24	..	.270	78
3/8	24	Q	.332	79
7/16	20	W	.386	79
1/2	20	..	.449	78
9/16	18	..	.506	78
5/8	18	..	.569	78
3/4	16	11/16	.688	77
7/8	14	..	.802	78
1	14	..	.927	78
1 1/8	12	..	1.040	78
1 1/4	12	..	1.165	78
1 1/2	12		1.415	78

TAP DRILLS—COARSE THREAD STANDARD

American National Standard—Coarse Thread

Size	Threads Per Inch	No. or Fraction	Decimal	Per Cent of Basic Depth
1	64	..	.058	76
2	56	51	.067	82
3	48	5/64	.078	77
		47	.079	76
4	40	44	.086	80
5	40	40	.098	83
		39	.100	78
6	32	36	.107	78
8	32	..	.132	78
10	24	26	.147	79
12	24	11/64	.172	82
		17	.173	79
1/4	20	9	.196	83
		8	.199	78
		7	.201	75
5/16	18	P	.257	77
3/8	16	5/16	.313	77
7/16	14	..	.364	79
1/2	13	27/64	.422	78
9/16	12	..	.472	83

Size	Threads Per Inch	No. or Fraction	Decimal	Per Cent of Basic Depth
5/8	11	17/32	.531	80
3/4	10	..	.648	79
7/8	9	49/64	.766	76
1	8	7/8	.875	77
1 1/8	7	63/64	.984	76
1 1/4	7	1 7/64	1.109	76
1 1/2	6	1 21/64	1.328	79
1 3/4	5	1 35/64	1.547	78
2	4 1/2	1 49/64	1.766	81
		1 25/32	1.781	76
2 1/4	4 1/2	2 1/32	2.031	76
2 1/2	4	2 15/64	2.234	82
		2 1/4	2.250	77
2 3/4	4	2 31/64	2.484	82
		2 1/2	2.500	77
3	4*	2 47/64	2.734	82
		2 3/4	2.750	77
	3 1/2	2 45/64	2.703	80
		2 23/32	2.719	76

DETERMINING HANDLOAD VELOCITIES

Captain M. K. Rabenstein, of the California National Guard, Martinez, California, has worked out a rather interesting system of determining handload velocities, as reproduced herewith. This material was received from Captain Rabenstein while this volume was going to press and is reproduced below for those who desire to experiment with his interesting theory. It should be borne in mind, however, that in order to use this system the bullet velocity *should exceed the velocity of sound*, which is approximately 1086 f.s. This eliminates the average revolver from these calculations.

The data submitted by Captain Rabenstein are tabulated as follows:

1. Velocities of practical loads always exceed that of sound. During flight, bullets displace air in such a manner as to produce a sharp, high-pitched tone. A gun report, when heard from a distance of a hundred yards, has a broad, low-pitched tone.

2. The gun report and muzzle exit of the bullet are simultaneous. The crack of the bullet can be heard at any point along its flight path, yet owing to the direction of the sound waves emanating from it, the sound will appear to come from a point in the path at right angles to the observer. This sound is produced by the collapse of the air and not from vibration of the bullet. The Doppler-Fizseau principle is thus not involved.

3. For the purpose of determining velocities it may be assumed that the crack of the bullet is caused by striking the target, as this is the location of the apparent source.

4. We now have two distinct sounds traveling from widely separated foci, and as they spread in all directions at uniform and equal speed a line of synchronism can be plotted, the characteristics of which will be determined by the radii of the wave fronts at the point of intersection.

5. An observer placed on a line with the front of the target and at right angles to the line of fire can easily find a point where the sound of the gun and that of the bullet are heard simultaneously.

6. It may be roughly stated that the distance of the observer from the target is the distance that the bullet preceded the gun report to the target. Note Chart 1.

7. The speed of sound is not affected by pitch or variation in barometric pressure. We need only to correct for temperature, which may be done by adding $T - 32$ to 1086; T, standing for temperature Fahrenheit, and 32 representing freezing point.

8. By subtracting the observed distance from the range, we obtain the distance the gun report traveled while the bullet traveled from the gun to the target. This figure establishes their relative velocities, and as that of sound is known, the other can be found by a simple equation.

9. Bullet travel divided by sound travel times velocity of sound in feet per second establishes average velocity of bullet over the range fired.

$$V = \frac{D}{D-d} \times 1100$$

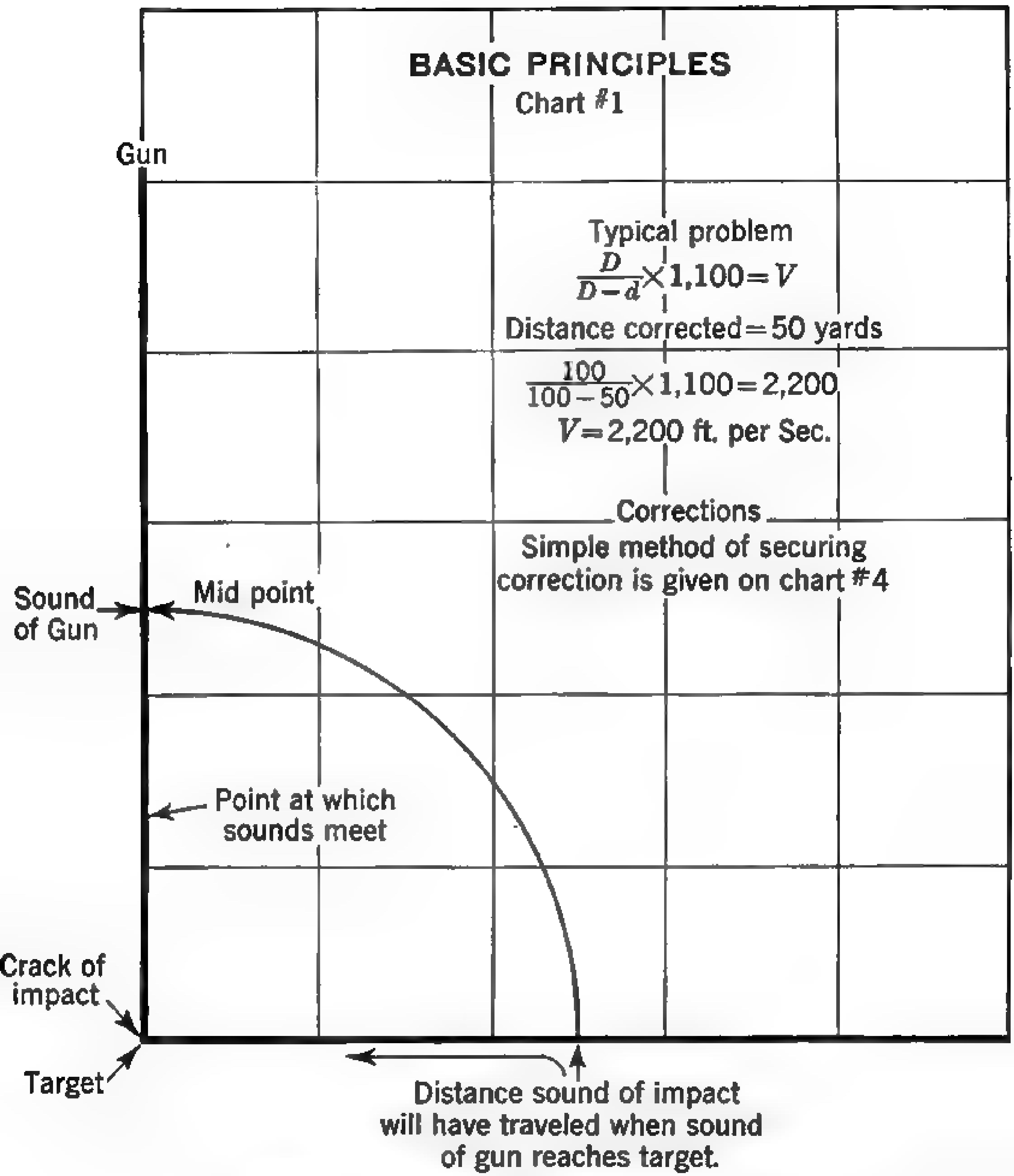
in which V is average velocity, D is range, d is observed distance minus corrections, and 1100 is speed of sound at 46° Fahrenheit.

10. Chart 1. Basic principles and solution of typical problem.

Chart 2. Method employed in plotting curves of coincidence.

Chart 3. A and B plotting of points of intersections on base line.

Chart 4. Curve secured from data developed from Chart 3. This plate is the key to the formula and provides the correction indicated for observed distance.



Note: This distance is exactly equal to the distance the bullet preceded the sound to the target. This being true then $\frac{D}{D-d} \times 1{,}100 =$ Average Velocity.

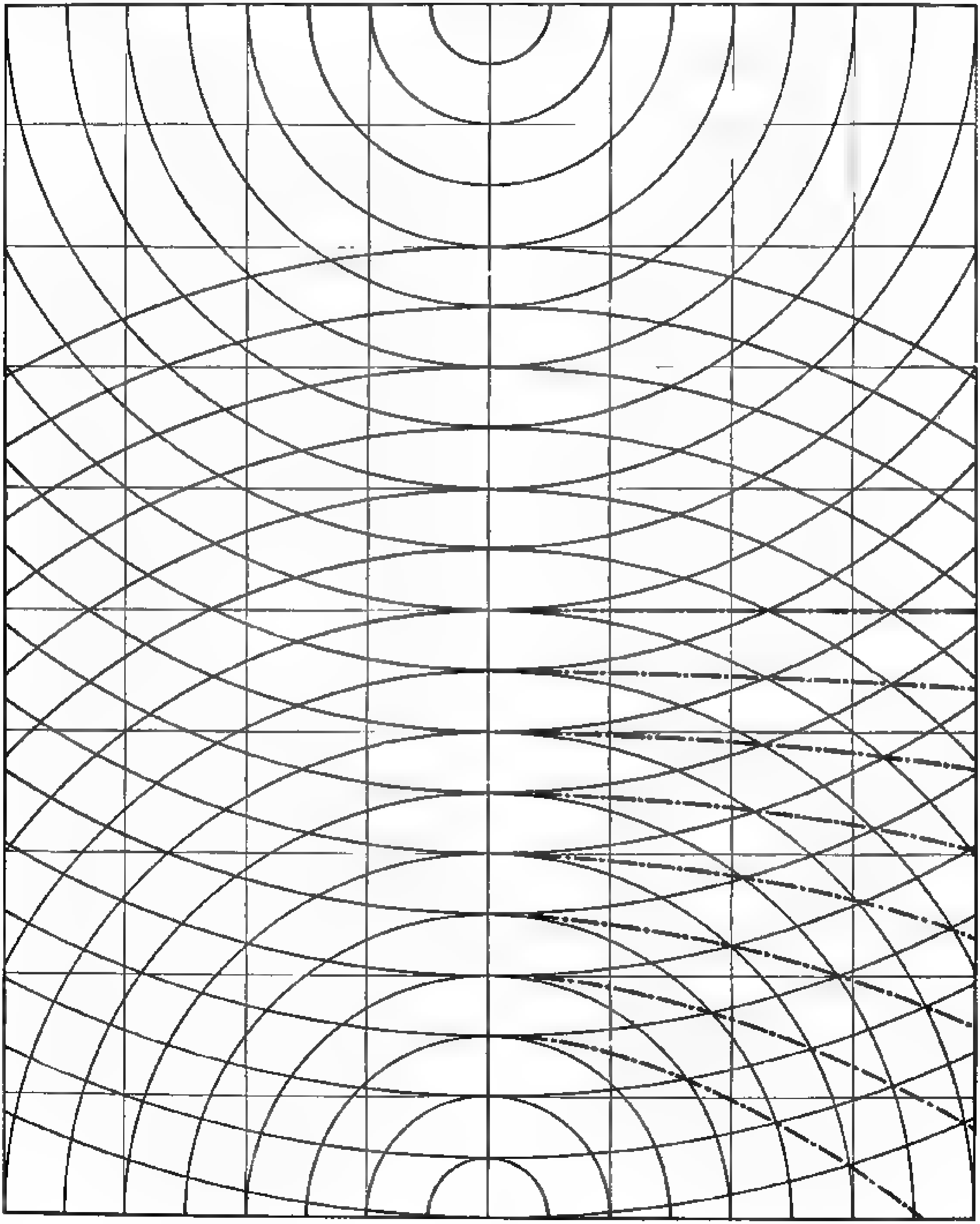
D = Range, d = observed distance, 1,100 = speed of sound at 46 F.

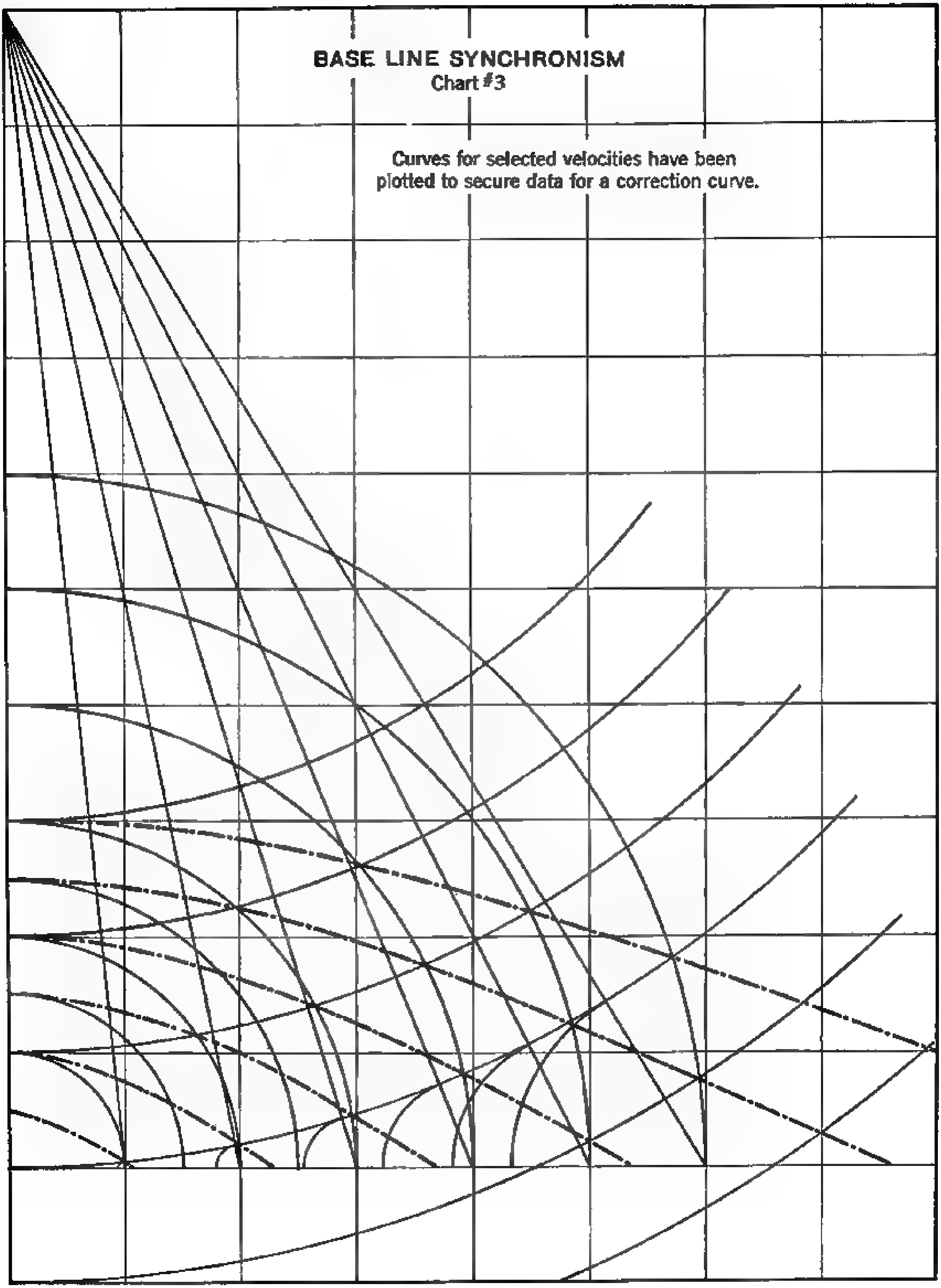
COINCIDENCE CHART

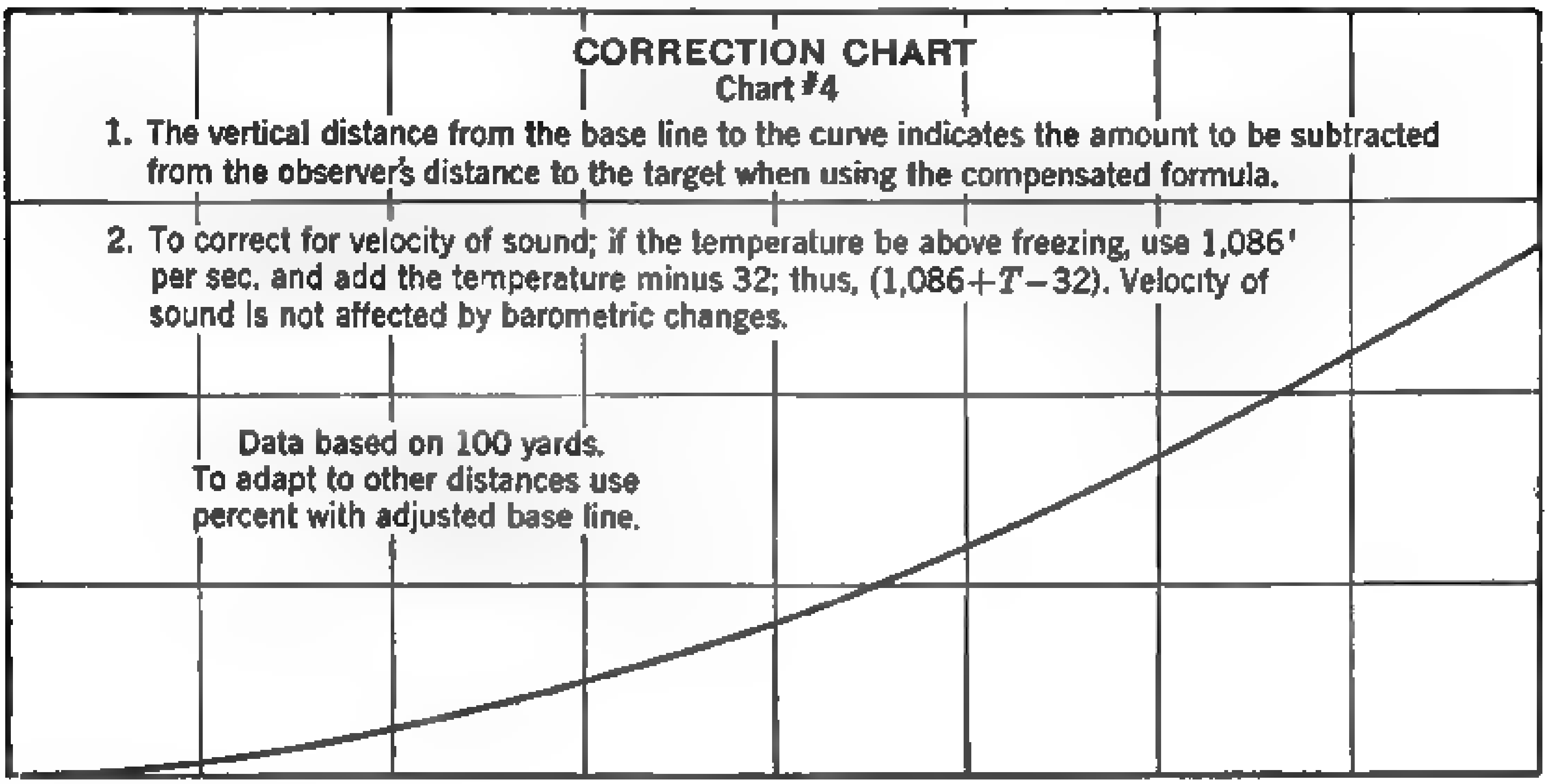
Chart #2

Legend:

Dot and dash curves indicate line of coincidence of sound waves emanating from two foci at variable times.




BASE LINE SYNCHRONISM
Chart #3
Curves for selected velocities have been plotted to secure data for a correction curve.



a. Dist.	10 yards	20	30	40	50	60	70	80
b. Sub.	3 feet	7'	14'	24'	36'	51'	66'	87'
c. Sub.	1 yard	$2\frac{1}{3}$	$4\frac{2}{3}$	8	12	17	22	28
d. Per cent	10%	12%	16%	20%	24%	28%	31%	35%

CURRENT PRIMERS COMMERCIALLY AVAILABLE

Since this volume originally went to press, there have been many changes in the primer field. Primers have blossomed and died. And an old favorite, the very excellent but corrosive chlorate primer, the famous "F.A. 70" is dead—gone, but not forgotten in this year 1952. Certainly it required cleaning of guns, but it was a fine primer; it gave perfect ignition and at lower pressures than many of the modern types. It also gave real accuracy to some of us who used it during its more than 30 years of existence. Many who still have a supply will feel badly when they are gone, but the non-corrosive primer is here to stay.

The primer situation is no longer critical. Below, the various primers are listed, but it must be pointed out that today, *all primers are alike, regardless of make or number designation!* The American non-corrosive primer has been in use by the several commercial ammunition makers for 28 years (as of 1953). It has gone through all of the growing pains and has been developed to perfection. Unusual though it may seem, the priming mixture has been standardized by all makers by Government request. It was decided that the lead styphnate mixture was the most reliable (see Chapter VII, Page 60) and this has been adopted universally. Commercial firms supply their primers to the Government in plain brass—the regular primer is nickeled. The 1953 story is:

FRANKFORD ARSENAL. Experimental only. Commercial primers being used, but their own non-corrosive type available only in primed shells through the DCM. Still fighting to get their development adopted. Unsuccessful after 10 years, but still trying.

WINCHESTER. With the exception of black powder blanks and a few shotshells, all primers are of the non-mercuric Staynless type—non-corrosive. The line includes the #108 small and #111 large pistol, and the #120 large rifle. The #116 small rifle is used in limited cartridges.

WESTERN. Their standard #1½ small pistol and #7 large pistol are used and the small rifle #6½ and large rifle #8½ remain. There are two special types—the #1½B, a mercuric corrosive used for blank cartridges which is not sold in bulk, and their #8½G mercuric corrosive primer used only in 30/06 and .300 Magnum match ammunition. It will be no longer sold to handloaders, nor will primed shells with this primer be sold.

FEDERAL. The Federal Cartridge Corporation of Minneapolis, long a producer of shotshells and .22 rimfire ammunition, produced millions of rounds of 30/06 ammunition during the recent war, and has developed a new non-corrosive which performs like all others. Millions have been supplied to the army since the war. These are now on the market as the Federal #210. It is the standard large rifle type—no small rifle or pistol primers are yet available. No change in loading data is required.

REMINGTON. All Remington primers made since the recent war use their improved Kleanbore non-mercuric non-corrosive mixture. Remington claims that this is a better mixture than that of their prewar primer. While mercuric primers are still used in some rimfires and shotshell loads, all primers and primed shells are as above indicated.

But four primers remain in the current line. The small pistol is still the #1½ and the large pistol is the #2½; the small rifle is the #6½ and the large rifle is the #9½. Other primers have been discontinued. Back in 1947 a few lots of the #9½ were made with a large "O" stamped on the cup, indicating that they were made for reloaders, but this was quickly discontinued.

PETERS. All primers are likewise of the non-mercuric non-corrosive type. The small pistol is #15 and the large pistol is #20X; the small rifle is #65 and the large rifle is #12. A special primer with softer cup is used on the factory-loaded .38/40 and .44/40 only, known as the #20B. Designed for lever-action firing pins, this is not sold. The #20X can be used in its place.

DOMINION. Although made in Canada by Canadian Industries limited, much of this ammunition and components is available in the United States. All primers are non-mercuric and non-corrosive. Their #1½ is the small pistol and #2½ is the large pistol. Their large rifle size is #8½. They do not make a small rifle, using the #1½ in these calibers. A special small pistol primer known as their #1 is used only in the .25 Auto and .32 caliber pistol ammunition.

FOREIGN PRIMERS. Many of these are available on the market, and while many are non-corrosive, they are *mercuric*. Most of these are of the Berdan type. Before attempting to reload foreign Berdan cases, you should check carefully to see if mercuric primers were previously used. Norma ammunition and RWS brands are non-mercuric and non-corrosive, and DWM is likewise. However, nothing is known about other imported brands except Kynoch, which is definitely mercuric.

PRICES OF COMPONENTS

(As of February 1, 1953 No Federal Tax)

CARTRIDGE	SHELLS	BULLETS
.218 Bee	$ 53.70	$ 28.60
.219 Zipper	82.70	39.90
.22 Hornet	53.70	28.60
.220 Swift	91.00	39.90
.22 Savage	82 70	39.90
.25 Automatic	31.60	23.10
.25/20 Winchester 86 gr. Lead	53 70	19.70
" S. P. & H. P.	53.70	28.60
.25 Remington	82.70	47.70
.25/35 Winchester	82.70	47.70
.250 Savage	91.60	47 70
.257 Roberts	91.60	47.70
.270 Winchester	95.40	47.70
7 mm. Mauser	95 40	57.60
.30 Mauser (7.63 mm.)	53.70	28.60
.30 Luger (7.65 mm.)	53.70	28 60
.30/30 Winchester	82 70	53.40
.30 Remington	82.70	53.40
.30/06 Springfield	95.40	57.60
.30/40 Krag	95.40	57.60
.300 H. & H. Magnum Mush. & S. P.	123.00	85 50
.300 Savage	91 60	57.60
.303 Savage	82.70	57.60
.303 British	95.40	61.30
.32 Winchester Special	82.70	53 40
.32 Automatic (7.65 mm.)	35.00	28 40
.32 Smith & Wesson	30.70	18.90
.32 Smith & Wesson Long	30.70	20.80
.32 S. & W. Long Targetmaster	30.70	24 40
.32 Short Colt	30.70	18.90
.32 Long Colt	30.70	18.90
.32 Colt New Police	30.70	20 80
.32 Winchester Self-Loading	53.70	49.80
.32 Remington	82.70	53.40
.32/20 Winchester 100 gr. Lead	53 70	20 80
" S. P. & Mush.	53 70	31.80
.32/40 Winchester	82.70	53.40
.33 Winchester	95 40	57.60
.351 Winchester Self-Loading	53.70	49.80
8 mm Mauser (7 9)	95 40	57.60
8 mm. Lebel	95.40	57.60
.348 Winchester	109.60	57.60
.35 Winchester Self-Loading	53.70	49.80
.35 Remington	91.60	57.60

CARTRIDGE	SHELLS	BULLETS
.357 Magnum	41.30	30.60
.357 Magnum Metal Point	41.30	.
9 mm. Luger	53.70	36.60
.38 Smith & Wesson	35.00	28.60
.38 Special Metal Penetrating	37.30	....
.38 Special 158 gr. Lead	37.30	30.60
" 158 gr. Metal Point	37.30	40.10
" 200 gr. Lead	37.30	34 80
.38 Special 148 gr. T. M.	37.30	30.60
.38 Special Hi-Way Master	37.30	. ..
.38 Short Colt	35.00	25.40
.38 Long Colt	37.30	28.60
.38 Colt New Police	35.00	28.60
.38 Automatic Colt	41.30	36.60
.38 Super Automatic Colt	41.30	36.60
.380 Automatic	35.00	36.60
.38/40 Winchester	53 70	44.50
.38/55 Winchester	82 70	57.60
.401 Winchester Self-Loading	70 00	60.80
.41 Long Colt	37 30	34.80
.44 Smith & Wesson Russian	41 30	42 60
.44 Smith & Wesson Special	41 30	42.60
.44/40 Winchester	53.70	44.50
.45 Colt	53 70	37.10
.45 Automatic Hi-Way Master	53 70	.
.45 Automatic Targetmaster	53.70	....
.45 Automatic Metal Case	53.70	47.70
.45 Automatic Rim	53.70	41.50
.45/70 Government	82.70	90.50

NOTES

The above prices are the standard retail as of this date. Prices of shells cover brass cases either primed or unprimed. In addition, the retail price of all pistol and rifle primers is $8 00 per 1000. Shotgun primers list at $14, and F C. percussion caps for muzzle loaders are available at $3.20 per 1000.

Although this author does not recommend the handloading of paper shotshells, and no information on the subject appears in this volume, empty primed paper shotshells, shot, and various felt and card wads are back on the market. See your dealer for prices.

CONVERSION TABLE MILLIMETERS TO INCHES

PREPARED BY. CAPT. PHILIP B. SHARPE
OSTD (EEIS) ETOUSA.

MM	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
0		.003937	007874	.01181	.015748	.019685	.023622	.027559	.031496	.035433
1	.03937	.043307	.047244	.051181	.055118	.059055	.062992	.066929	.070866	.074803
2	.07874	.082677	.086614	.090551	.094488	.098425	.102362	.106299	.110236	.114173
3	.11811	.122047	.125984	.129921	.133858	.137795	.141732	.145669	.149606	.153543
4	.157480	.161417	.165354	.169291	.173228	.177165	.181102	.185039	.188976	.192913
5	.196850	.200787	204724	.208661	.212598	.216535	.220472	.224409	.228346	.232283
6	.236220	.240157	.244094	.248031	.251968	.255905	.259842	.263779	.267716	.271653
7	.275590	.279527	.283464	.287401	.291338	.295275	.299212	.303149	.307086	.311023
8	.314960	.318897	.322834	.326771	.330708	.334645	.338582	.342519	.346456	.350393
9	.354330	.358267	.362204	.366141	.370078	.374015	.377952	.381889	.385826	.389763
10	.393700	.397637	.401574	.405511	.409448	.413385	.417322	.421259	.425196	.429133
11	.433070	.437007	.440944	.444881	.448818	.452755	.456692	.460629	.464566	.468503
12	.472440	.476377	.480314	.484251	.488188	.492125	.496062	.499999	.503936	.507873
13	.511810	.515747	.519684	.523621	.527558	.531495	.535432	.539369	.543306	.547243
14	.551180	.555117	.559054	.562991	.566928	.570865	.574802	.578739	.582676	.586613
15	.590550	.594487	.598424	.602361	.606298	610235	.614172	618109	.622046	.625983
16	.629920	.633857	.637794	.641731	.645668	649605	.653542	.657479	.661416	.665353
17	.669290	.673227	.677164	.681101	.685038	.688975	.692912	696849	.700786	.704723
18	.708660	.712597	.716534	.720471	.724408	.728345	.732282	.736219	.740156	.744093
19	.748030	.751967	.755904	.759841	.763778	.767715	.771652	775589	.779526	.783463
20	.787400	.791337	.795274	.799211	.803148	807085	.811022	.814959	.818896	.822833
21	.826770	.830707	.834644	838581	.842518	846455	850392	.854329	.858266	.862203
22	.866140	.870077	.874014	.877951	.881888	.885825	.889762	893699	.897636	.901573
23	.905510	.909447	.913384	.917321	.921258	.925195	.929132	.933069	.937006	.940943
24	.944880	.948817	.952754	956691	960628	.964565	.968502	.972439	.976376	.980313
25	.984250	.988187	.992124	.996061	.999998	1.003935	1 007872	1 011809	1.015746	1.019683
26	1.023620	1.027557	1.031494	1.035431	1.039368	1.043305	1.047242	1.051179	1.055116	1.059053
27	1.062990	1.066927	1 070864	1.074801	1.078738	1.082675	1.086612	1.090549	1.094486	1 098423
28	1.102360	1 106797	1.110234	1.114171	1.118108	1.122045	1.125982	1.129919	1-133856	1.137793
29	1 141730	1.145667	1 149604	1 11535	1.157478	1.161415	1.165352	1 169289	1.173226	1.177163
30	1.181100									

SUPPLEMENTAL—HUNDREDTHS OF A M/M

MM	.01	.02	.03	.04	.05	.06	.07	.08	.09
	.0003937	.0007874	.001181	0015748	.0019685	.0023622	.0027559	.0031496	0035433

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Following this Index is a
New Supplement, with a separate Index.

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